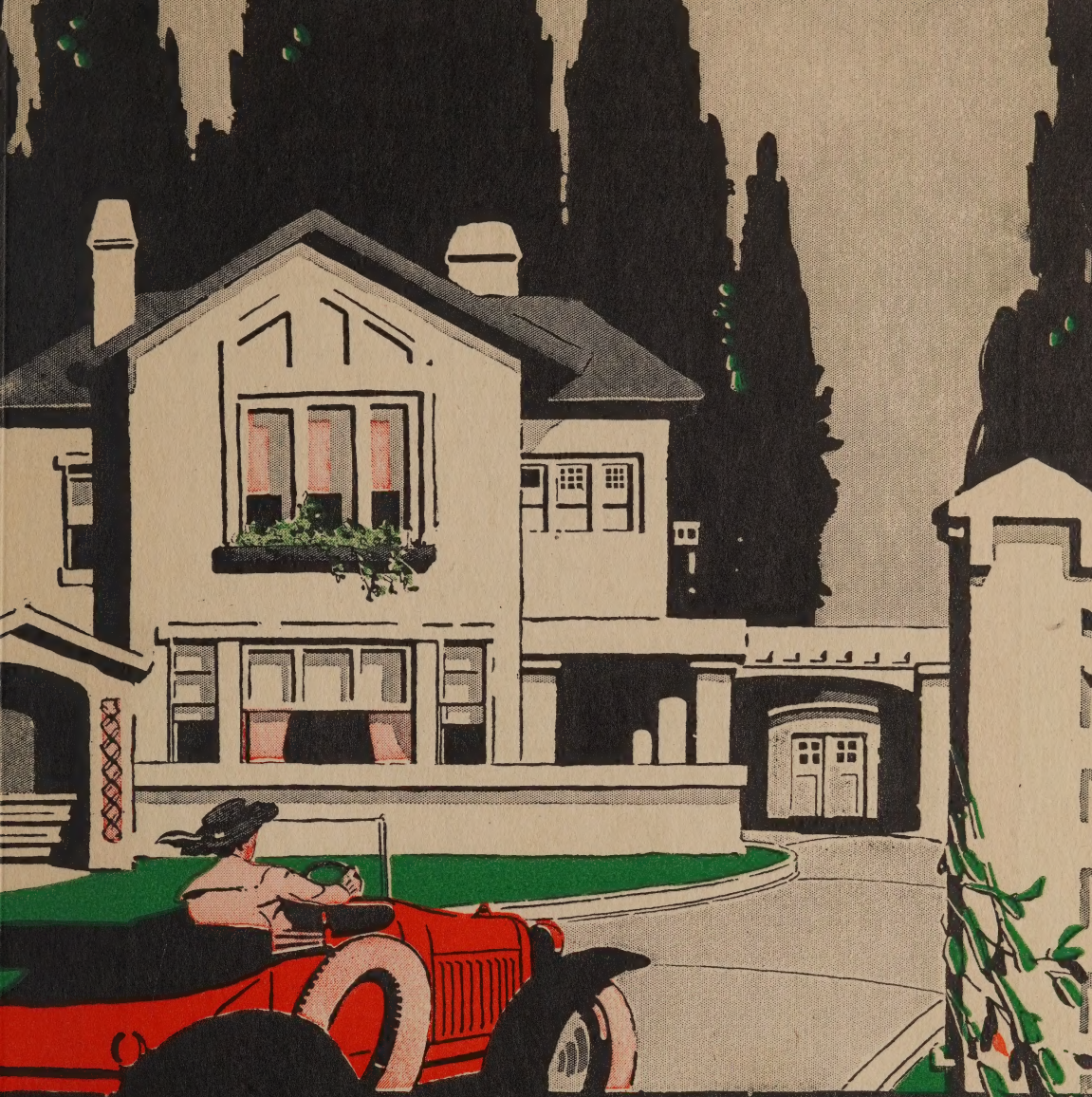




ALPHA

THE GUARANTEED PORTLAND

CEMENT

How to use it



TESTS EVERY HOUR DAY AND NIGHT

UNIFORMITY is a prime requisite of cement. When the proportions for the concrete have been fixed upon, it is necessary that every bag of the cement used be up to a high standard of quality.

The uniformity of ALPHA CEMENT is safeguarded by systematic testing which begins with quarry borings. These tests by expert chemists are applied hourly at every ALPHA plant. The ALPHA policy is to make its chemists men of real authority. Their decisions as to quality are absolute. The result is that it is impossible for any cement that will not set properly to be shipped from an ALPHA plant. Every bag is guaranteed—and stamped "Guaranteed"—invariably to meet standard specifications.

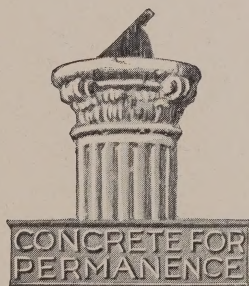
Test ALPHA if you prefer, but you don't have to.

ALPHA
THE HOURLY TESTED AND
GUARANTEED PORTLAND
CEMENT



ALPHA THE GUARANTEED PORTLAND CEMENT

HOW TO USE IT



ALPHA PORTLAND CEMENT COMPANY

WORKS:

Alpha, N. J. Martins Creek, Pa. Manheim, W. Va. Cementon, N. Y.

GENERAL OFFICES: EASTON, PA.

BRANCH OFFICES:

NEW YORK...Hudson Terminal Building
BOSTON.....Board of Trade Building
PITTSBURGH.....Oliver Building

PHILADELPHIA Harrison Building
BALTIMORE Builders' Exchange
SAVANNAH..... National Bank Building

Copyright 1915, 1917, by ALPHA PORTLAND CEMENT CO., Easton, Pa.

Bringing Down 100,000 Tons of ALPHA CEMENT Rock

This picture was taken at the Martins Creek (Pa.) ALPHA plant at the time of firing $10\frac{1}{2}$ tons of dynamite loaded in thirteen 6-inch holes, bored 160 to 170 feet deep down the entire face of the quarry. 100,000 tons of high quality cement rock were dislodged.

This rock has just the proportions for a perfect Portland Cement.

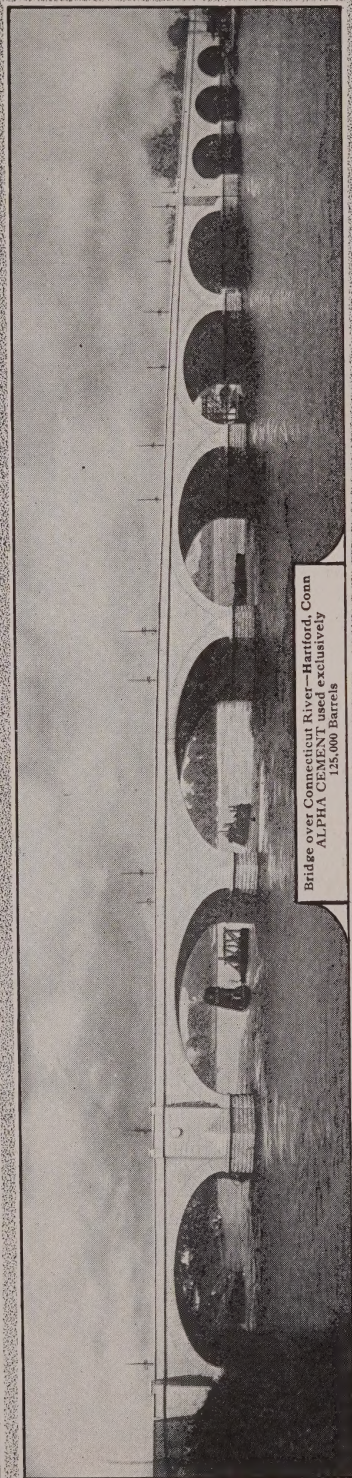
In every ALPHA plant there is the same rigid testing of every boring and the same careful mixing of the rock. Tests of the product are made hourly by expert chemists.

In uniform composition, thorough burning, fine grinding and correct ageing ALPHA CEMENT represents the high-water mark of quality.

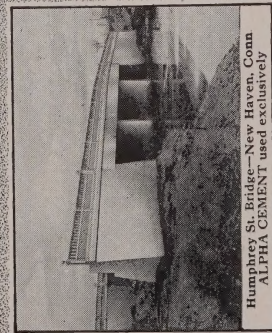


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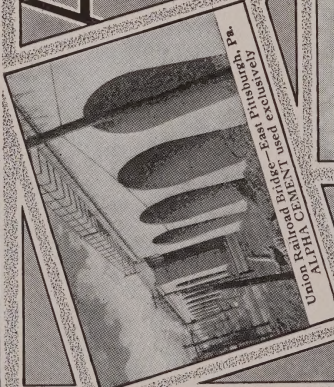
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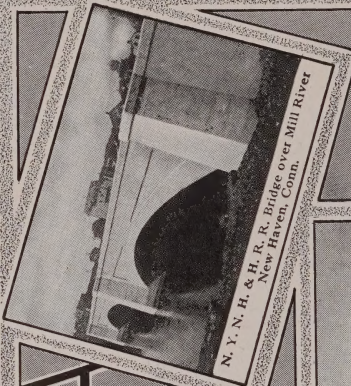
Bridge over Connecticut River—Hartford, Conn.
ALPHA CEMENT used exclusively
125,000 Barrels



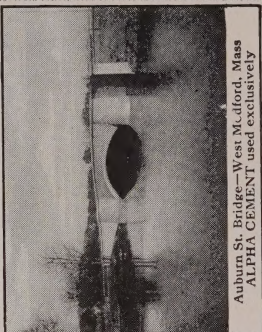
Humphrey St. Bridge—New Haven, Conn.
ALPHA CEMENT used exclusively



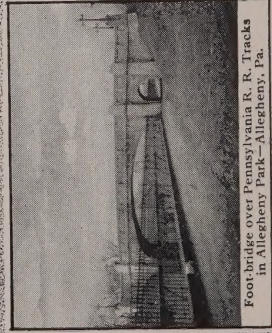
Union Railroad Bridge—East Pittsburgh, Pa.
ALPHA CEMENT used exclusively



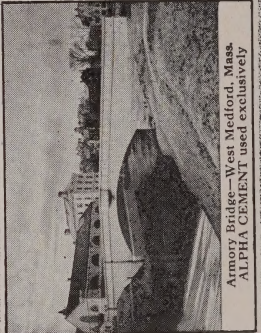
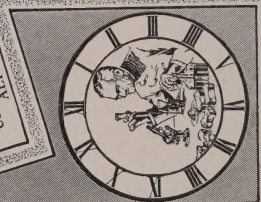
N. Y. N. H. & H. R. R. Bridge over Mill River
New Haven, Conn.



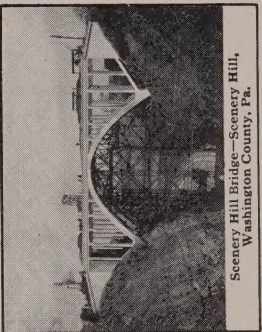
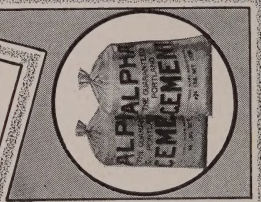
Auburn St. Bridge—West M. dford, Mass.
ALPHA CEMENT used exclusively



Foot-bridge over Pennsylvania R. R. Tracks
in Allegheny Park—Allegheny, Pa.



Armory Bridge—West Medford, Mass.
ALPHA CEMENT used exclusively



Scenery Hill Bridge—Scenery Hill,
Washington County, Pa.

Some Everlasting ALPHA CEMENT Bridges

Concrete Construction and Portland Cement



THE WORD "CONCRETE" refers to sand and pebbles or crushed stone, or other hard material such as slag, hard cinder, broken brick, etc., which has been thoroughly mixed with Portland Cement and water and allowed to harden.

Portland Cement is the most tenacious binding material or mortar known. When properly mixed with the other materials named, it binds with a grip that makes the entire mass as hard and imperishable as if it were cut from solid stone. This "manufactured stone" has rapidly become the principal building material, where strength, durability, and protection against fire, water, rats, etc. are essential.

As concrete requires, in addition to cement, only the most commonplace and easily procured materials—sand, stone, and water—and is simply made, being merely mixed thoroughly, cast in place, and allowed to remain in forms until the hardening takes place, concrete construction has a wonderful growth. Its earliest general use was in great engineering undertakings—bridges, retaining walls, sea walls, and the like, but now that the advantages of concrete have become universally recognized, a great list of buildings and improvements, ranging from such small constructions as fence posts to the largest factories and warehouses, are being everywhere built "the everlasting way."

Why Cement is Called "Portland"

"Portland" is merely a generic name, such as "wrought" as applied to iron,

or "Russia" or "sole" as applied to leather. The name was applied to this class of cement because, when Joseph Aspdin, of Leeds, England, discovered the method of making the cement, the product had a "fancied though really slight resemblance to the noted oolitic limestone from the Isle of Portland, on the South coast of England." That oolitic limestone, which by the way is used in the London Westminster Cathedral, was known as "Portland Stone"; hence it seemed natural to give the name "Portland Cement" to the new product that made stone resembling Portland Stone.

There are now almost as many different brands of Portland cement as there are brands of flour or lime.

Increase in Use of Portland Cement

Some idea of the widespread increase in the use of Portland Cement may be gained from the fact that 8,482,000 barrels were manufactured in America in 1900, while the present yearly output is close to 100,000,000 barrels. The United States at present leads all other countries in production, and cement is produced at many different points—with raw materials that vary according to the section of the country. Clay, limestone, marl, cement rock, etc. are used.

How "ALPHA" Cement is Made

The raw materials for cement-making contain lime, silica, alumina and still other constituents. These materials are excavated, weighed, dried, proportioned

ALPHA CEMENT — HOW TO USE IT

with great care, and then ground to a fine powder. This ground raw material is then subjected to an intense heat, over 2500° F., in great rotary kilns, until it is "calcined to incipient fusion,"—to use the chemist's terms. The clinker formed by this process is again ground—this time to an impalpable powder—so that more than three-fourths of it will pass a screen containing 40,000 meshes to the square inch. This twice-ground and thoroughly burned fine powder is Portland Cement.

The best grade of Portland Cement, mixed pure, gives a tensile strength on "standard tests" of from 600 to 800 pounds in 28 days, while natural cement, the strongest mortar material known up to the discovery of Portland Cement, reached only about 225 pounds. Moreover, concrete made of Portland Cement continues for months, probably for years, to gain strength. Just how long it continues to grow stronger is not definitely known, but it is sufficient to be assured that properly built concrete structures are practically imperishable. They stand fire, water, and wear, eliminate painting and repairing; keep interiors cool in summer and warm in winter, are attractive and sanitary. With so many advantages, it is scarcely to be wondered at that concrete construction is increasing by leaps and bounds.

Portland Cement hardens under water as well as out of it; hence it is doubly useful and makes easily possible structures that otherwise would present difficult problems.

"ALPHA" History and Policy

The Alpha Portland Cement Company was a pioneer manufacturer of American Portland Cement, and it came into the field in 1891, when first the English Portland Cements and later the German Portlands were regarded as being of the best quality. The original ALPHA equipment of two 40-foot kilns and the yearly output of 100,000 barrels seem indeed small when compared with the group of modern ALPHA plants now able to produce in four days as much cement as the original plant produced in a year.

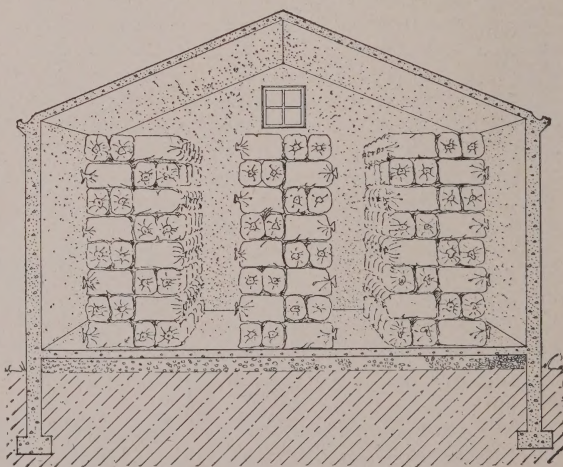
The ALPHA Company concluded in the beginning to make only one grade of Portland Cement and to have that of such

a quality that it would be a credit to the company behind the brand. That policy has been continued through the quarter of a century that has elapsed. Neither sharp competition nor zeal for impressive output at low cost has ever been allowed to lower the quality of ALPHA Portland CEMENT. And ALPHA Service is kept on a par with the high quality of ALPHA CEMENT.

Experience has shown that the policy of the Alpha Portland Cement Company is correct. More and more the discriminating buyer shows his appreciation of the product whose standard of quality is invariably high—that can be depended on whether the usual tests are applied or not.

How to Store Portland Cement

Portland Cement is sold nowadays mostly in cotton or paper bags containing 94 pounds net, which is approximately one cubic foot of cement. Shipment in barrels is confined almost entirely to export trade. Cotton bags are used a number of times and are bought back by cement manufacturers and dealers when in good condition, thus reducing package cost to the cement user. It is very important that cement to be stored any length of time prior to use shall be protected from moisture. Sacks or bags which have become wet are unsuited to further use as cement containers and are therefore not accepted for redemption.



Concrete storage house with cement correctly piled

ALPHA CEMENT — HOW TO USE IT

Cement should never — never — be piled on the ground which always contains some moisture. An improvised floor will protect cement.

The illustration shows a cement storage shed built of reinforced concrete, and the best manner of piling sacks for convenience as well as air circulation. The shed should be ventilated so that the difference between temperatures inside and outside will not subject the cement to injury from dampness.

The concrete floor in such a building should be of one-course construction, of a 1:2:3 mixture, laid on a well-drained fill of clean cinders or gravel. Even then it is best to lay stringers on the floor and place on these loose planks so as to provide ventilation beneath the piles of sacks. If a frame building is used for cement storage, a tight board floor should be constructed far enough above the earth to provide good ventilation and prevent

the cement from absorbing dampness. This floor should be double with moisture-proof building paper between the two courses of boards. The roof should, of course, be leak-proof and as a safeguard against moisture, no cement should be piled next to building walls.

Any cement that has become wet is worthless, unless it is used at once before it begins to set.

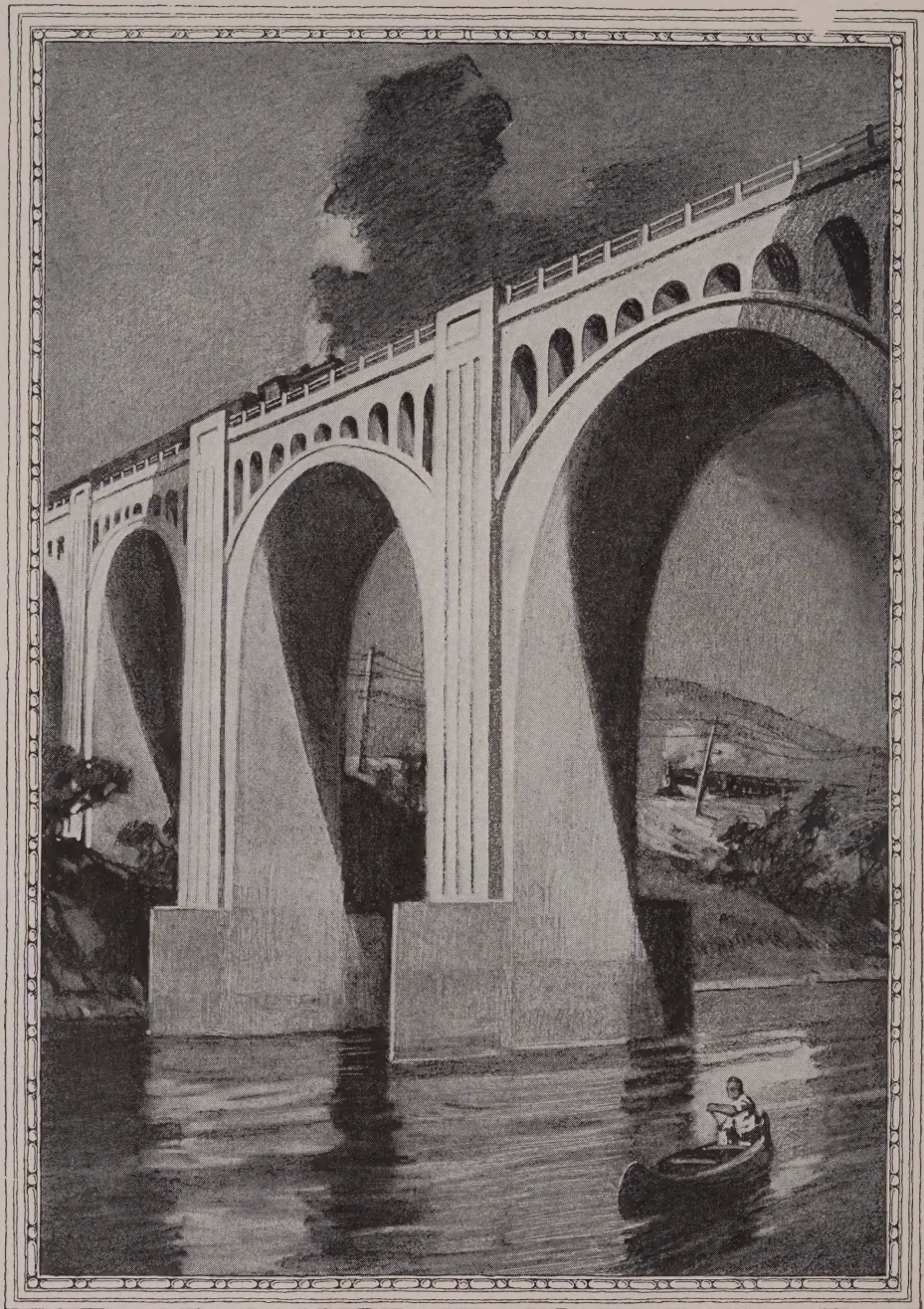
If kept in storage for a considerable time, cement in sacks which were at the lower portion of piles is likely to become storage caked from compression under the weight of the sacks above in the piles. A blow from a shovel will usually put such cement back to its previous condition. Lumps that may readily be crushed between the fingers are good. Any lumps which cannot be readily crushed, are partially set from absorbed moisture and should be rejected in order to insure the strength of the concrete to be made.



When the Big Guns Roar

nearby concrete construction is called upon to stand unusual concussion and strain. The stone, sand and cement must be of unquestioned quality.

In building the fortifications at Egmont and Mullet's Keys, Forts Hancock, Wadsworth, Slocum, Monroe, Strong, Mott, Totten and Schuyler and in making concrete improvements at the Brooklyn, Portsmouth, Boston, Norfolk, Charleston and League Island Navy Yards, at West Point, Annapolis, and elsewhere the United States Government has used hundreds of thousands of barrels of ALPHA CEMENT.



D. L. & W. R. R. Bridge

(Delaware River, Portland, Pa., just below the Water Gap.)

TREMENDOUS loads; speedy trains; swift currents; great masses of ice piling through the famous Delaware Water Gap; these are some of the conditions which had to be taken into account by the D. L. & W. R. R. engineers, who planned this extraordinary structure.

Today this magnificent bridge, containing more than 300,000 bags of ALPHA CEMENT, stands as an everlasting monument to American engineering skill and to the dependability of ALPHA CEMENT.



Materials, Proportioning, Mixing and Placing

GOOD cement is necessary to make good concrete. But Portland Cement no matter how good, can not make good concrete if mixed with sand, pebbles, broken stone or similar materials that are unsuitable.

ALPHA CEMENT meets the severest engineering and other specification requirements, thus relieving the user of further concern in that direction.

Most of the dissatisfaction experienced in the use of concrete can be traced to improperly graded sand, or sand containing loam or sand with clay-coated particles.

Sand that can be pulverized, that soils the hands, or that smells, will not make good concrete. To test sand, stir it in a glass of water. If it settles leaving the water clear with very little sediment, it is good. A heavy sediment is an indication that the sand is of doubtful quality. The best engineering practice is to reject sand if it contains more than 5 per cent. of loam.

Where strength and wearing qualities are demanded of concrete, the sand to be used should contain an excess of coarse particles. Fine sand is necessary in a mixture only in the grading of the whole bulk of sand, to reduce the volume of air spaces or voids in the mass. To be well adapted for concrete work, the greater part of the sand should remain on a 50-mesh sieve—a sieve containing 50 linear divisions to the inch or 2500 holes to the square inch. Not more than 6 per cent. should go through a 100-mesh sieve. All particles passing $\frac{1}{4}$ inch mesh are regarded as sand in concrete work. Small particles of clean stone from rock crushers, known as “screenings,” if from hard durable rock, answer very well as sand. River sand averages well because usually the mud has been washed out of it. In concrete work, sand or materials used in its stead are known as “fine aggregate.” Pebbles, broken stone or similar materials over $\frac{1}{4}$ inch are used in concrete are known as “coarse aggregate.”

Coarse Aggregate. Usually the maxi-

mum size of aggregate, that is, pebbles or broken stone, is $1\frac{1}{4}$ or $1\frac{1}{2}$ inches in diameter for most concrete work. Some concrete work such as concrete block, concrete fence posts, require a smaller maximum size; $\frac{3}{4}$ inch, for instance, is the usual maximum in fence-post manufacture, while the maximum of $1\frac{1}{2}$ inches may at times be exceeded where the work is particularly massive, such as in some foundations. In very thick walls, dams, etc., large stone can be safely used provided it is clean and so placed as to be entirely surrounded by the cement and sand mixture.

No pebbles, broken stone or other similar aggregate should exceed in greater dimension, half the thickness of the section in which they are used.

Trap Rock, Granites, Gravel. Like sand, pebbles or broken stone must be free from loam, clay or similar matter. They must be hard. Concrete cannot be stronger than the materials of which it is composed. Hard granites, trap rock, hard pebbles from some gravel deposits, and slag, usually make the strongest concrete, provided the sand also has been selected with a view to uniform grading from fine to coarse and is composed of hard particles. Shale, slate, soft limestone and any material that crumbles, slivers or peels off, should be avoided. Having both the sand and the coarse aggregate of different sizes—so that the smaller particles will fit in between the larger—will reduce voids or air spaces in concrete. See the illustration at top of page 10. Elimination of voids in this way, provided the correct amount of cement is used, accomplishes watertightness, resulting in denser, and therefore stronger concrete.

Use of Bank-Run Gravel. Natural deposits of combined sand and pebbles almost invariably contain a large excess of sand and it is true economy, as well as the best practice, to screen bank-run material and reportion the sand and pebbles correctly.

ALPHA CEMENT — HOW TO USE IT



FIG. 1 Sand filling voids of large stone.

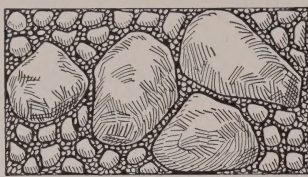


FIG. 2 Sand and small stone mixed with large.

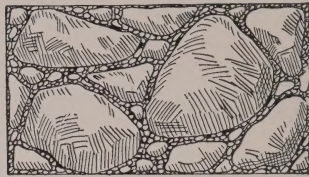


FIG. 3 Mixture of graded stone and sand.

In most gravel banks the quantity of sand—particles ranging from fine to $\frac{1}{4}$ inch size—is twice that of the pebbles, while for good concrete the proportions *should be about the reverse*. For instance, in a 1:2:4 mixture (see page 11), in which the particles of sand and pebbles are uniformly graded, voids or air spaces between the particles are reduced to such an extent that the sack of cement when added will practically fill these voids and hence produce the greatest possible density; that is, the 4 cubic feet of pebbles, well graded from $\frac{1}{4}$ inch to about $1\frac{1}{2}$ inches, contain air spaces which the well graded 2 cubic feet of sand will fill, while the air spaces in the combined sand and pebbles will be filled by the cement. In fact, these proportions are such as to make a slight excess over and above that required for reducing the voids, and the concrete resulting from combining the 1 sack of cement, 2 cubic feet of sand and 4 cubic feet of pebbles will measure about 4.5 cubic feet in volume. This shows how the cement and sand have disappeared, so to speak, among the air spaces or voids in the bulk of pebbles.

If, as is often done, 6 cubic feet of material just as it comes from the gravel bank are used instead of the 2 cubic feet of sand and 4 cubic feet of pebbles, it can readily be seen that we start off in the first instance with a bulk of 6 cubic feet of material and the 1 sack of cement used would be entirely taken up in the air spaces, leaving a bulk of 6 cubic feet containing 1 sack of cement. Compare this with the other method, where the 4.5 cubic feet of concrete also contains 1 sack of cement. It requires but little thought to realize that the latter mixture must be denser and stronger on account of the greater relative proportion of cement contained.

Cinders as Aggregate. Cinders are used to some extent as a substitute for

crushed stone or gravel. They are lighter and more porous than stone and less strong, but where lightness is more important than strength or where a poor conductor of heat or sound is required, they may be used. Successive floors of tall buildings are often laid with cinder concrete. Roofs are also constructed with it. Cinder concrete may be cut more easily than concrete made of stone; nails may be driven into it. The cinder used for concrete work should not contain much, if any, fine ashes. Wood ashes should not be used at all. The cinders from power plants are better than ashes from household furnaces because the intense heat of the former fuses most of the ash into hard material, leaving little or no fine matter. Where the cinders have been drenched with water as soon as drawn from the furnace, they are still better, for the reason that the fine material is washed out. Cinders are easily crushed, and it is better practice not to ram concrete in which they are used, because the breaking up of the aggregate means increasing the surface to be covered by the cement. Both slag and cinders absorb more water than pebbles or crushed stone and therefore require more wetting. As cinders have been subjected to intense heat, the material is good from a fireproof point of view.

Slag. Blast furnace slag which has been properly air-cooled and aged is suitable aggregate for concrete work. Copper, lead, or basic open-hearth slag should not be used; such materials are usually very brittle, have a glassy surface and readily cause disintegration. Slag that shows any signs of granulation has come into contact with water while hot and partial disintegration has taken place. Only slag that has been slowly cooled should be used. As there is considerable variation in the quality of slag, this material should be used with care. The best grade of slag

ALPHA CEMENT — HOW TO USE IT

is regarded by some engineers and builders as giving greater crushing strength to concrete than any other form of aggregate. Slag is particularly well adapted for concrete where light weight and fire-resisting qualities are desirable, as in floors, roofs, etc.

Proportioning. Concrete is usually proportioned by volume. For extreme precision and economy on large work, it is advisable to proportion mixtures under

the guidance of laboratory tests, which are made to determine the exact percentage of voids of air spaces in the volumes of sand and pebbles or broken stone used. But on most concrete work, experiments and tests have proven the following arbitrary mixtures suitable to the classes of work here designated.

Such figures as 1:2:3 indicate one part of cement—volume, not weight—to two parts of sand and three parts of the coarser aggregate.

Table of Recommended Mixtures

1:1:1 Mixture for

The wearing course of two-course floors subject to heavy trucking, such as occurs in factories, warehouses, on loading platforms, etc.

1:1:1½ Mixture for

The wearing course of two-course pavements, in which case the pebbles or crushed particles of stone are graded from ¼ to ½ inch.

1:2:3 Mixture for

Reinforced concrete roof slabs
One-course concrete road, street and alley pavements
One-course walks and barnyard pavements
One-course concrete floors
Fence posts
Sills and lintels without mortar surface
Watering troughs and tanks
Reinforced concrete columns
Mine timbers
Construction subjected to water pressure, such as reservoirs, swimming pools, storage tanks, cisterns, elevator pits, vats, etc.

1:2:4 Mixture for

Reinforced concrete walls, floors, beams, columns and other concrete members designed in combination with steel reinforcing

Concrete for the arch ring of arch bridges and culverts; foundations for large engines causing heavy loading, some impact and vibration

Concrete work in general subject to vibration

Silo walls, grain bins, coal bins, elevators and similar structures

Reinforced concrete sewer pipe

1:2½:4 Mixture for

Building walls above foundation, when stucco finish will not be applied

Walls of pits or basements, subject to considerable exposure to moisture but practically no direct water pressure

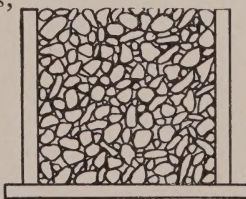
Manure pits, dipping vats, hog wallows



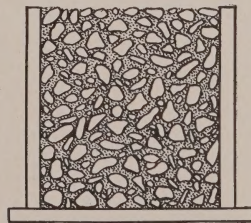
1 bag of CEMENT
(about 1 cu. foot)



2 cu. feet of
SAND



4 cu. feet of
STONE



Slightly over 4 cu. feet of
CONCRETE

Illustration of a 1:2:4 mix. Note that as the sand merely fills the voids of the stone and the cement fills the voids of sand, the seven cubic feet of material make a batch of only a little over 4 cubic feet of concrete. Beginners in concrete work often err in thinking that the volume of the concrete will equal the total volume of materials used.

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Body of concrete block
Base of two-course pavements

1:2½:5 Mixture for

Walls above ground which are to have stucco finish
Base of two-course sidewalks, feeding floors, barnyard pavements and two-course plain concrete floors
Abutments and wing walls of bridges and culverts, dams, small retaining walls
Basement walls and foundations for ordinary conditions, where watertightness is not essential
Foundations for small engines

1:3:6 Mixture for

Mass concrete such as large gravity retaining walls, heavy foundations and footings

Mortar

Cement and Sand Only

1:1½ Mixture for

Inside plastering of water tanks, silos and bin walls, where required, and for facing walls below ground when necessary to afford additional protection against the entrance of moisture
Back plastering of gravity retaining walls

1:2 Mixture for

Scratch coat of exterior plaster (cement and stucco)
Facing blocks and similar cement products
Wearing course of two-course walks, floors subjected to only light loads, barnyard pavements, etc.

1:2½ Mixture for

Intermediate and finish stucco coats
Fence posts when coarse aggregate is not used

1:3 Mixture for

Concrete block when coarse aggregate is not used
Concrete brick
Concrete drain tile and pipe when coarse aggregate is not used
Ornamental products
Mortar for Masonry (When desired, lime may be added up to 15 per cent. by volume of cement).

How to Figure Amounts of Materials

The first step in calculating quantities is, of course, to figure the total cubic space to be occupied by the concrete, which is learned by the simple method of reducing the dimensions to like units of measurement; for example, having all dimensions, feet or fractions of feet, and multiplying breadth and thickness together. For example, if a floor or driveway is to be 30 feet long by 12 feet wide and 6 inches thick, we have 30 by 12 by ½ equals 180 cubic feet, which divided by 27, the number of cubic feet to the yard, gives 6⅔ cubic yards of volume.

Figuring a Foundation. A foundation that is to be 1 foot thick, 10 feet high, 25 feet wide and 40 feet long would be figured as 1 by 10 by 23 equals 230 for the short wall and 1 by 10 by 40 equals 400 for the long wall. The reason for using 23 as the building length of the short wall is that if the long wall is figured the full length, its thickness will of course lessen the length of the short wall one foot at each end. As there are two short walls and two long ones, the totals of 230 and 400 would be double, giving 1260 cubic feet, from which should be deducted space occupied by doors and windows.

Amounts of Cement, Sand and Stone.

In thoroughly mixed batches of concrete about 100 cubic yards of stone will be required for a job that has a cubic volume of 100 yards. Voids vary somewhat, but usually voids in crushed stone will average about 45 per cent. and the voids in gravel about 40 per cent.

The simplest rule for mixing a batch of concrete is to take the proportions as a table of cubic feet. Thus, if the proportion is 1:2:4, use four cubic feet of stone, two of sand and one of cement. As most proportions used in concrete work call for a quantity of sand that is 50 per cent., or a little more than 50 per cent. of the bulk of the stone, the quantity of sand will slightly exceed the 40 or 45 per cent. of voids and thus the mix for a cubic yard of cement will overrun a yard. In proportioning by volume, a sack of cement is considered as one cubic foot, and by weight, a sack of cement may be accepted as 94 pounds net.

ALPHA CEMENT — HOW TO USE IT

Table 1 will be found very useful in calculating the quantities of sand and gravel, or stone, required for a one-bag batch of mortar or concrete, and in computing the volume of the resulting mortar or concrete.

It will be observed from Table 1, that the volume of finished concrete will overrun slightly when the rule is followed of using the same number of cubic yards of stone as there are cubic yards of volume in the job to be undertaken. Thus, when five yards of stone are used in a 1:2½:5 mixture the table gives the result of 5.4 yards of finished concrete. This difference comes mainly because the amount of sand used is slightly in excess of actual voids.

Example of Use of Table 1. If 100 cubic yards, or 2700 cubic feet, of space are to be filled with a 1:2½:5 mixture, 2700 should be divided by 5.4 in order to get the multiple of 500. 500 by 1 equals 500, which is the number of cubic feet or bags of cement to be used. 500 by 2½ equals 1250, which is the number of cubic feet of sand to be used, and 500 by 5 equals 2500, amount of stone actually needed, no overrun being provided for.

Quantities by Weight for Differently Proportioned Concretes. The common practice is to sell sand and stone by the ton, and Table 2 gives the quantities of cement, sand, and stone required for concrete of different proportions. This is a more accurate table than No. 1, as quantities are given by weight instead of volume. Weights are given per cubic yard with the corresponding weights per cubic foot. The table is based on 45 per cent. voids in the coarse aggregate.

Mixing

Proper mixing of materials, with the right amount of water, determines very largely the strength and watertightness of concrete. Too often concrete is mixed with less or with more water than is necessary.

Such terms as "wet" "soupy," "medium" "quaky" and "dry" while not always accurate in their description of consistency of a mixture, are nevertheless in general use. They describe in the order here named, the variations from wet to dry.

Quaky Mix. This consistency—jelly-like—is preferred in a mixture for nearly

TABLE 1

Mixtures			Materials			Vol. in Cu. Ft.	
Cement	Sand	Gravel or Stone	Cement in Sacks	Sand Cu. Ft.	Gravel or Stone Cu. Ft.	Mortar	Concrete
1	1.5	..	1	1.5	..	1.75	..
1	2.0	..	1	2.0	..	2.1	..
1	2.5	..	1	2.5	..	2.5	..
1	3.0	..	1	3.0	..	2.8	..
1	1.5	3	1	1.5	3	..	3.5
1	2.0	3	1	2.0	3	..	3.9
1	2.5	4	1	2.5	4	..	4.5
1	3.0	5	1	3.0	5	..	4.8
1	2.0	5	1	2.5	5	..	5.4
1	3.0	5	1	3.0	5	..	5.8

TABLE 2

MATERIALS REQUIRED FOR ONE CUBIC YARD OF CONCRETE

Cement by Bag; Sand and Stone by Ton of 2000 Pounds

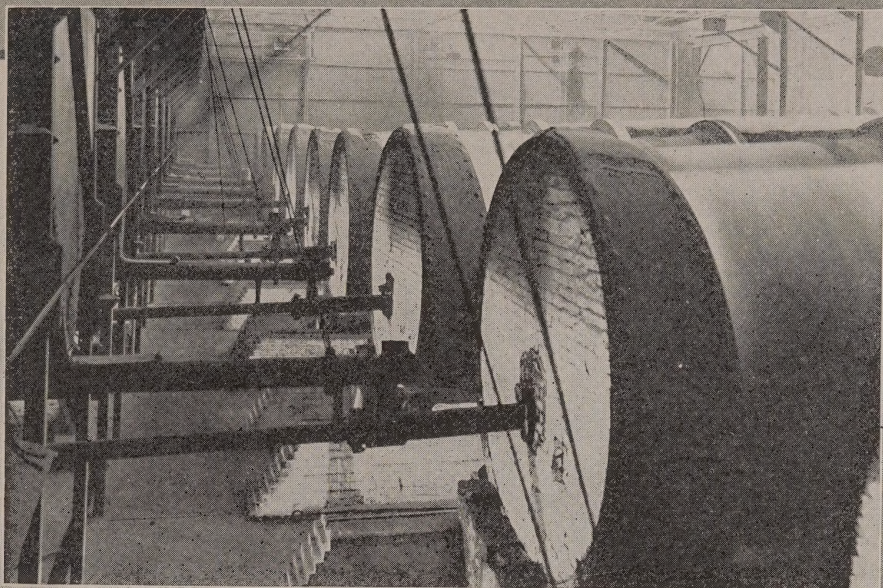
Proportions			Cement	Sand of Various Weights						Stone of Various Weights											
Cement	Sand	Stone		Cu. Yd. 2400 Lbs. Cu. Ft. 88.9 Lbs.	Cu. Yd. 2500 Lbs. Cu. Ft. 92.6 Lbs.	Cu. Yd. 2600 Lbs. Cu. Ft. 96.3 Lbs.	Cu. Yd. 2700 Lbs. Cu. Ft. 100 Lbs.	Cu. Yd. 2800 Lbs. Cu. Ft. 103.7 Lbs.	Cu. Yd. 2900 Lbs. Cu. Ft. 107.4 Lbs.	Cu. Yd. 3000 Lbs. Cu. Ft. 111.1 Lbs.	Cu. Yd. 3100 Lbs. Cu. Ft. 114.8 Lbs.	Cu. Yd. 3200 Lbs. Cu. Ft. 118.5 Lbs.	Cu. Yd. 3300 Lbs. Cu. Ft. 122.2 Lbs.	Cu. Yd. 3400 Lbs. Cu. Ft. 125.9 Lbs.	Cu. Yd. 3500 Lbs. Cu. Ft. 129.6 Lbs.						
1	1½	3	Bags	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons					
1	2	3	7.64	.504	.525	.546	.567	.589	.611	.634	.656	.678	.700	.722	.744	.766					
1	2½	4	6.96	.624	.650	.676	.702	.728	.754	.780	.806	.832	.858	.884	.910	.936					
1	3	5	6.04	.540	.562	.585	.607	.629	.651	.673	.695	.717	.739	.761	.783	.805					
1	3½	6	5.56	.612	.637	.663	.688	.713	.738	.763	.788	.813	.838	.863	.888	.913					
1	4	7	5.32	.468	.487	.507	.526	.546	.565	.585	.604	.624	.643	.663	.682	.702					
1	4½	8	4.96	.552	.575	.598	.621	.644	.667	.690	.713	.736	.759	.782	.805	.828					
1	5	9	4.64	.624	.650	.676	.702	.728	.754	.780	.806	.832	.858	.884	.910	.936					
1	6	10	4.24	.564	.587	.611	.634	.657	.680	.703	.726	.749	.772	.795	.818	.841					



1 This illustration shows the great Martins Creek quarry of the Alpha Portland Cement Company just after the $10\frac{1}{2}$ -ton dynamite blast. At regular intervals, during the boring of the blasting holes, a sample of the rock was taken for preliminary analysis. These analyses are made by chemists whose duty it is to keep constant and strict watch over the quality of ALPHA CEMENT. This care begins with the boring of blasting holes and continues through every step of ALPHA CEMENT manufacture —always under the trained eye of chemists.

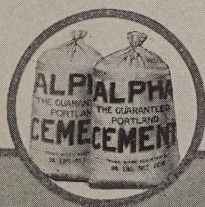
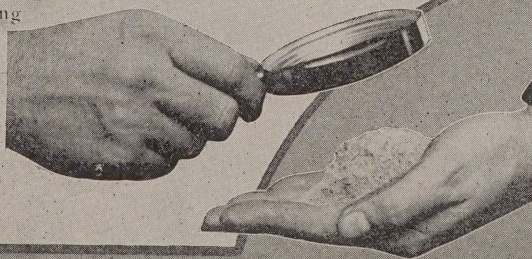
3 After having been thoroughly burned in the great rotary kilns for about one and three-quarter hours, the materials of which ALPHA CEMENT is made come out in the form shown here—a gray clinker. This clinker, when cool, is subjected to the second grinding process, and this time the grinding is so fine that the finished product will more than meet the standard requirement: that 78 per cent. will pass a sieve having 40,000 holes to the square inch. The cement is then largely an impalpable powder, so fine that when properly mixed it makes a paste that coats the sand and stone of the concrete thoroughly.





2 When the raw materials for ALPHA CEMENT have been proportioned with great care, and the mixture has been dried and ground finely, the powder is conducted into the high end of the great kilns shown above, which are 140 feet long. Here the material is subjected to intense heat, created by a flaming blast of finely powdered coal—the temperature running 2,500 to 3,000° F. in the burning zone of the kiln. As the kilns slowly revolve, the powder travels downward. The entire burning and grinding operation is supervised by chemical and efficiency engineers in all ALPHA plants.

4 ALPHA CEMENT can always be depended on for uniform fineness. If you will use the microscope on a handful of ALPHA you will see no underground particles to lower the binding power, but a smooth, flour-like powder that can be counted on for first-class results. Chemists are real bosses in all ALPHA CEMENT plants, and no zeal for large output or low operating cost can alter their decisions. All ALPHA CEMENT is of one grade—the best that a quarter century of experience and the most modern equipment can produce, from quarries that are famous in the cement-making world.



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all classes of general construction. Such a mixture will, when heaped into a pile, gradually flatten of its own weight, yet at no time in handling it will there be a separation between the sand-cement mortar and the pebbles or broken stone. Too much water in such a mixture would cause a separation of materials, forming pebble pockets or porous spots, resulting in a concrete of variable density when placed. Too little water, on the other hand, would prevent complete "hydration" of the cement and cause a weakened concrete mixture. "Hydration" means the chemical changes which take place in cement resulting in complete hardening. The quaky or jelly-like consistency contains about the correct amount of water to accomplish this result. Forms surrounding earth—as in the case of foundations—absorb some of the water and this should be taken into account.

Wetter Mixes. There are, however, several conditions under which one must use mixtures containing more or containing less water than described by the word "quaky." For instance, in some reinforced concrete work where the wall or section being placed is thin, it is necessary to use slightly more water so that the concrete can be well puddled around the reinforcing metal and thus be caused to adhere or bond it firmly.

Drier Mixes. Concrete block made in

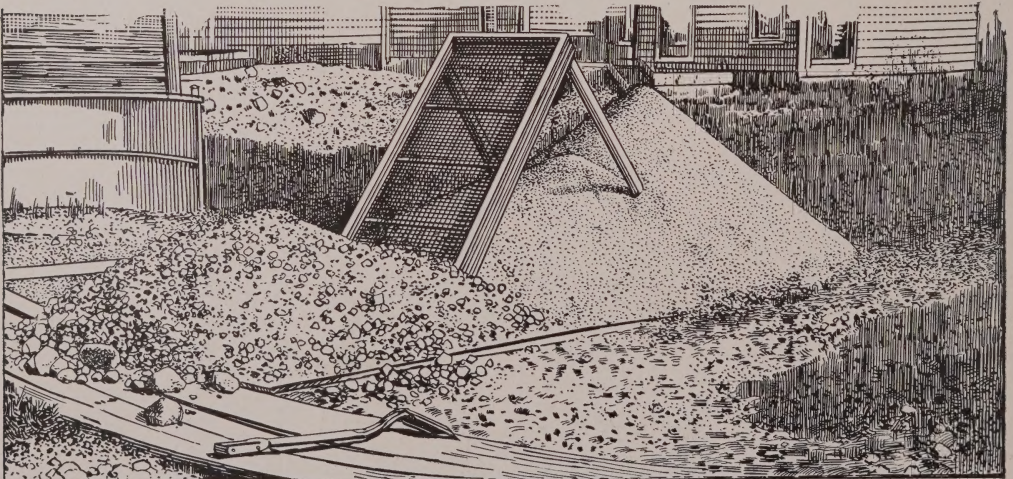
certain types of machines, and concrete drain pipe or tile, are good examples of cases where mixtures should contain less water than the "quaky" consistency.

In the case of drain tile and pipe, the mixtures used should contain enough water so that when the molds are removed from the product or vice versa, distinct water markings will show on the surface of the tile, thus indicating that the revolving core or packer head of the machine has been working in a concrete wet enough to cause free moisture to flush to the surface. Such a mixture can be used in any of the modern block machines.

Water. The simplest specification for mixing water is to say that it shall be good enough to drink. If this requirement is met, the water is suited for use in a concrete mixture.

Methods of Mixing

Good concrete can be made by hand mixing, but unless laborers are carefully watched and instructed as to the best way of turning materials, imperfectly mixed concrete is likely to result. Machine mixing is more dependable, especially in the batch type of mixer. These come in almost any desired capacity and are relatively low in cost. Many cement and building material dealers rent such mixers to their cement customers, and often farmers join in groups and buy power mixers that all of them can use.



The stone or gravel should be screened out of the sand. A screen with a quarter-inch mesh will remove the coarser matter from the sand

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Mixers of the batch type are preferable since measured materials must be put in the drum for each batch, while in the continuous type of mixers there is always possible some variation in moisture content or proportions of materials that may cause the concrete to lack uniformity.

Length of Time in Machine Mixers. Often concrete has been mixed for too short a period of time. Most mixer manufacturers recommend the number of revolutions per minute at which the drum of their machines should be revolved for best results. Whether mixed by hand or machine, mixing should continue until the concrete is of uniform color and consistency. Care should be taken when machine mixing not to revolve the mixer drum too rapidly, otherwise materials will cling to its surface and not be tumbled about, hence will be imperfectly mixed. As a general rule, no batch of concrete which is machine mixed should be removed from the drum until mixing has continued for at least one minute and in certain types of machines, $1\frac{1}{4}$ or $1\frac{1}{2}$ minutes would be better.

Working Methods in Hand Mixing. For measuring materials a bottomless box or frame of 1 or 4 cubic feet capacity should be placed on a board, filled to the required level, and lifted off. Mixing by means of shovelfuls or wheelbarrow loads is uncertain. A frame that holds 4 cubic feet, should be marked on the inside at various levels to indicate 1, 2 and 3 cubic feet. Cement need not be measured in proportioning a mixture unless a batch requiring a smaller quantity than 1 sack is to be mixed, as 1 sack (94 pounds net) is, for convenience, considered 1 cubic foot in proportioning concrete mixtures.

Few tools are needed for mixing and placing concrete. A platform 8 by 14 feet made of tongued and grooved $1\frac{1}{2}$ or 2-inch stuff so that tight joints will result, is necessary for hand mixing. A strip nailed around the outer edges on three sides will prevent the loss of cement that might be carried away when adding mixing water. Square - pointed shovels are necessary for turning the materials on the board. A sprinkling can, or hose with nozzle, a water barrel, measuring box, wheelbarrows, tampers, spading tools, a

wood float, screen, steel trowel and possibly a groover and edger, are about all the tools needed.

In mixing a one-bag batch by hand in the proportions of 1:2:4, first spread out the two cubic feet of sand on the board. Distribute one bag of cement over the sand as evenly as possible. Then with shovels, turn this material thoroughly, first dry and then wet, applying the water evenly. Now spread this mortar out and place the four cubic feet of stone on top. This mass should be turned repeatedly, with water being applied evenly. Note the illustration on page 18 which shows the usual method of turning with the shovels. The turning process must be kept up until the mass is thoroughly mixed. It is better to err in the direction of turning the material too often than to fail to mix well enough. Streaks of cement indicate that the mixing is not thorough. It is better to keep the pile of stone wet beforehand, so it will already have absorbed some water. The method here described is not the only way by which concrete can be mixed. In fact, any method by which the various materials will be thoroughly mixed is satisfactory, but this plan has the advantage that the stone—which is the heaviest material and costs the most to shovel—is not added until the cement and sand have been into a mortar. Where bank-run gravel has about the right proportions of sand and coarse material and is to be used, spread that out on the mixing board and put the cement on top. Turn with the shovel several times dry, then sprinkle the material thoroughly and continue the turning process until the mass has been shoveled not less than four or five times. Shoveling the mixed materials into wheelbarrows will answer as one turning. A rake should not be used in mixing batches when the coarser material has been added as it draws the larger stone away from the smaller. Some use the rake to mix the cement with the sand.

All materials, tools, etc. should be placed near the mixing board, so as to reduce labor as much as possible.

Sand and cement should never be mixed long before the pebbles and water are added to complete the mixture, because all sand contains sufficient moisture

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to start a setting of the cement which would rob the concrete of some strength.

It is very necessary in mixing concrete that all of the particles of sand be thoroughly coated with a film of neat cement and water, and that the resulting mortar shall be sufficient to coat thoroughly the larger particles of broken stone so that the whole mass will be firmly bound together. Broken stone, especially some limestones, contain a great deal of fine dust. This prevents a good bond between the mortar and stone.

Placing the Concrete. Immediately after mixing the concrete should be placed. This suggests where possible to do so, the mixing platform, or the mixer, be located near the point where concrete is to be placed. This makes it convenient to shovel the concrete directly into forms.

Spading to Secure Density and Good Surface. Concrete batches are spaded into place rather than tamped. A convenient tool for spading is an old garden spade, or a hoe which has been straightened out so that the blade is in line with the handle. Special spading tools also are made with perforations in the blades which assist to bring the sand-cement mortar against form faces while holding back the coarse particles in the concrete

and in this way produce a smooth surface finish when forms have been removed.

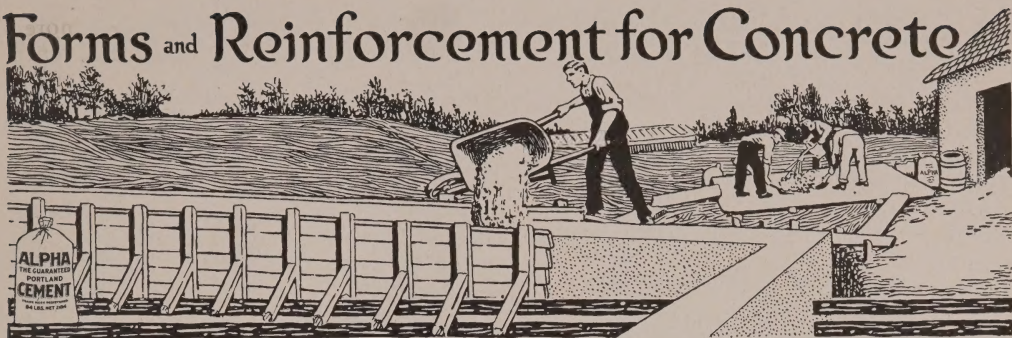
Protection of Fresh Concrete

Regardless of how carefully the materials for any concrete work may have been selected, proportioned, mixed and placed, the resulting success or failure must depend largely on whether or not the concrete is protected against too rapid drying out after it is placed. If suitable protection is not afforded, the concrete instead of hardening, simply dries out as a result of evaporation of a large portion of the mixing water. Concrete construction which exposes a large surface area to sun and wind, such as walks, feeding floors, barnyard pavements, etc., must be protected against rapid drying out by a layer of some moisture-retaining material. Sand, sawdust, hay, straw, old canvas, burlap, carpets, or similar covering applied as soon as the concrete surface can be covered without marring it, accomplishes the purpose. Such coverings should be kept wet by frequent sprinkling for from a week to ten days or more, depending upon the nature of the work and the temperature conditions. Manure may be used for this purpose only if means are provided for preventing manure from coming into direct contact with the fresh concrete and spoiling its appearance.



Care should be taken to see that the cement is mixed *thoroughly* with the sand and stone. This may be done by shoveling the materials back and forth, turning it over each time, until the mass has a uniform color and all the stone is coated with cement-mortar

Forms and Reinforcement for Concrete



IN order to use a concrete mixture, forms or molds are necessary so that the mass when hardened will have assumed the required shape and form. For a number of classes of concrete construction and products such, for instance, as sewers, silos, double monolithic building walls, concrete block, brick and tile, there are various types of patented forms and machines which permit quite a range of adjustments to adapt them to various dimensions of structures or products for which they are designed. Such forms or molds are almost invariably made of metal, sheet steel being the material principally used.

By far the largest part of concrete building construction is, however, done by using wooden forms; and as it is rare for any two structures to be of exactly the same dimension and detail throughout, more or less special form work has to be done for each particular job. It is possible, however, to design wood forms as unit panels, somewhat like that shown in Fig. 1, having dimensions of 2 by 4 feet or 2 by 6 feet or more, so that the forms may be used repeatedly, at least on certain parts of any square or rectangular structure.

Wood forms are often lined with galvanized iron or sheet steel to make them more durable and to assist in producing a smooth surface on the finished concrete.

Various kinds of lumber may be used for form construction. When moldings or decorative trim is to be reproduced in concrete, white pine is desirable as it may be worked easily; but white pine is rather expensive, and being soft is not very durable. Hard woods are also expensive and difficult to work. Norway pine and spruce are probably used most for form work.

Contrary to the usual practice in building construction, green lumber or lumber which is only partly air-dried will keep its shape in concrete forms for rectangular construction better than lumber that is kiln-dried. If kiln-dried lumber is used it should be thoroughly wet before concrete is placed. This is because the lumber will absorb water from the concrete, and if the forms are made tight, as they should be, the swelling from absorption will cause the forms to buckle or warp. Oiling or greasing the inside of forms before use is recommended, especially where forms are to be used repeatedly as it prevents absorption of water and also assists in keeping them in shape when not in use.

It is often possible to build forms from stock lengths of lumber, without cutting

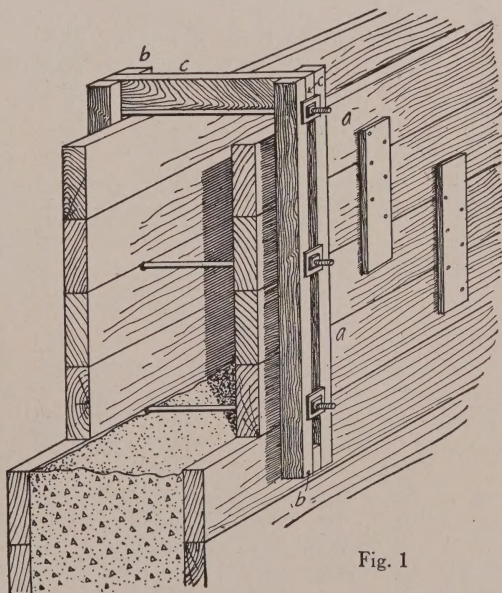


Fig. 1

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and thereby wasting material. After use, forms so built may be carefully taken apart and the lumber can be put to other uses. A form for a column footing, for example, may sometimes be made as shown in Fig. 2 without cutting lumber.

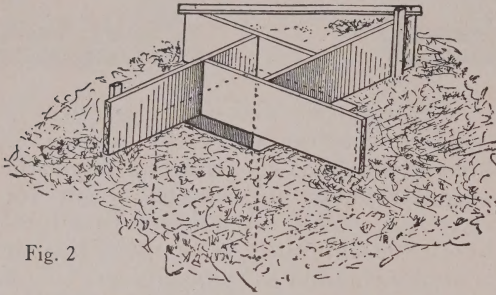


Fig. 2

Form lumber should be free from loose knots or other defects and irregularities that would be reproduced by the concrete. Lumber that is planed on both edges and one side is preferable, as it will give a smooth surface finish to the concrete. It is very essential that lumber for form work, where the concrete is to be exposed, be of uniform thickness, as when nailed to the studs any inequalities of thickness

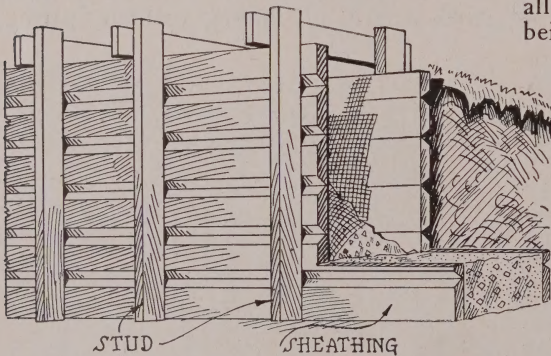


Fig. 3

will result in an irregular surface on the concrete. As a rule, 1, 1½ and 2-inch lumber is most used. The added cost of dressed lumber is more than offset by the convenience in handling, working up and placing. Tongued-and-grooved lumber is often used for form sheathing, although what is known as shiplay is better. Lumber having slightly beveled edges is shown in Fig. 3 and is preferred by many

because when it swells the edges will mash together enough to result in tight joints; this prevents water from leaking away and carrying cement with it.

Usually 2 by 4's, 2 by 6's, or in extreme cases 2 by 8's are used as form studs. The volume of concrete, or weight that must be supported determines the dimensions and spacing of form studs. Forms constructed of 2 by 4's, with one-inch sheathing, should have studs spaced not more than two feet apart, in order to prevent any bulging of the sheathing when subjected to the ramming of placing concrete, and its outward pressure until hardened.

Forms must be braced thoroughly when set up, and then held the correct distance apart by spacers, these being removed just before the concrete reaches them. Bolts or wire ties may be used to hold forms against the spacers and from spreading apart. If bolts are used they may be greased before concrete is placed so they can be driven out of the concrete easily when forms are removed. It is best to break the bond of the concrete around such bolts within 24 hours. This may be done by merely tapping them with a hammer. Wire ties are generally used and are cut when taking down forms, all of the wire, except the projecting ends, being left in the concrete. Fig. 4 shows how the forms are tightened against spacers by twisting the wire ties.

When a concrete foundation is not to enclose a cellar or basement, it will often be found that the soil is

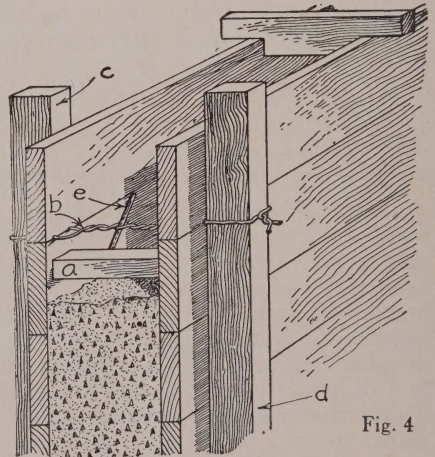


Fig. 4

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sufficiently self-sustaining to permit depositing concrete in the foundation trench without forms, as in Fig. 5. For all work above ground, however, forms are required; these may be of various types as illustrated in Figs. 5, 6, 7 and 8. Fig. 6 shows a form such as would be used where the earth is self-sustaining and a smooth face on the concrete is necessary only on the inside, as for a cellar wall.

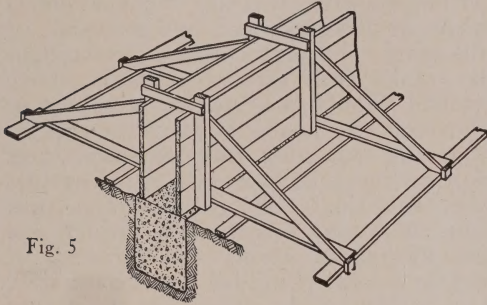


Fig. 5

As many foundations are provided with a footing, this may sometimes be constructed by omitting to nail sheathing boards on the lower eight or ten inches of the form studs as resting in the foundation trench, thus allowing the first concrete deposited to spread out and form the footing. See Fig. 8.

As concrete weighs from 130 to 150 pounds per cubic foot, floor and roof forms particularly must be designed with a sufficient factor of safety to prevent them

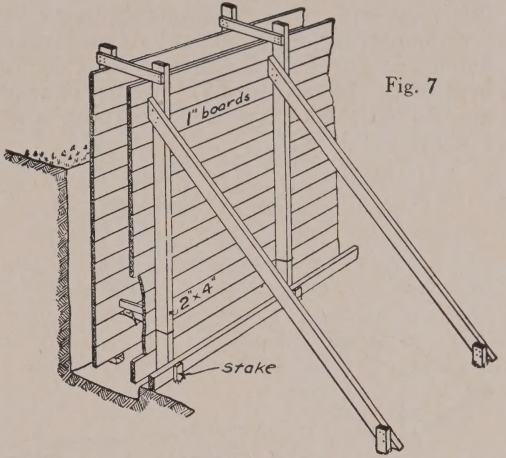


Fig. 7

from sagging from their own weight as well as that of the concrete. Any sagging of forms will result in small cracks developing while the concrete is hardening, and these will gradually widen, preventing the construction from having the desired strength. Enough braces, struts, and studs must be used to prevent forms from sagging. Various methods of bracing are shown in the illustrations.

Forms should be designed with every regard for economy of lumber, and when assembling them as few nails as possible should be used. In some cases screws and clamps used instead of nails will permit removing forms with the least hammering and least injury to the fresh concrete.

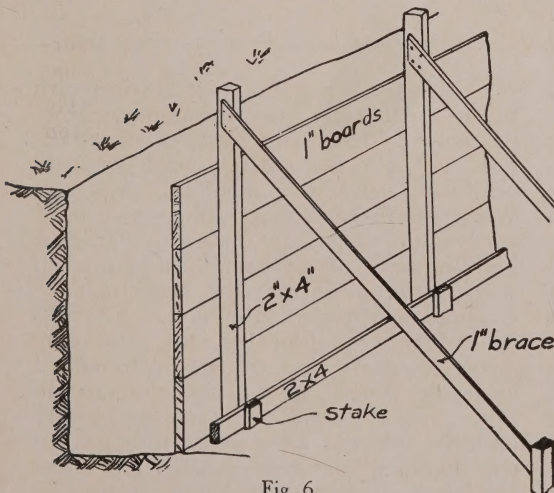


Fig. 6

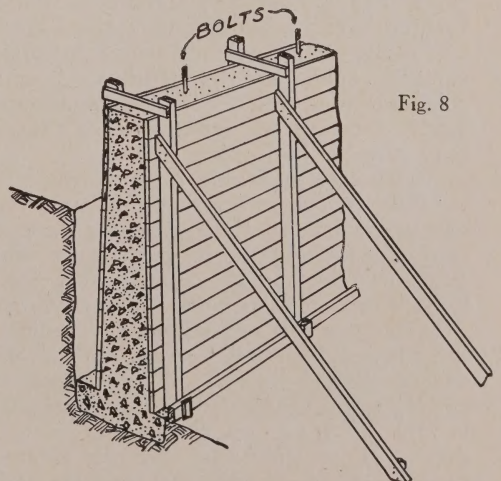


Fig. 8

ALPHA CEMENT — HOW TO USE IT

No very wide boards should be used in form construction, from four to six inches being the preferred widths, with eight inches as the maximum. Wider boards are difficult to keep from warping and bulging.

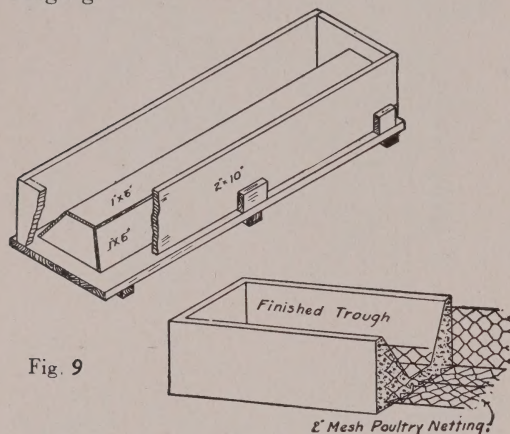


Fig. 9

Forms for floors laid on the ground, and for walks, should consist of two-inch lumber having a width equal to the desired thickness of the floor or walk and should be staked in position. Very few nails if any are needed in forms for walks, feeding floors and similar pavements. Stakes well driven will hold form boards in proper position.

Straight walls and flat floors usually require the simplest types of forms. These can often be built for from \$10 to \$20 per thousand board measure. Corners, offsets, bends and various kinds of breaks or projections from the plain surface, such as in columns, beams, cornices and walls with openings and angles increase the labor cost so that it may range a little higher.

With care in taking down forms it is possible to use lumber several times, so the longer it is in service the less the percentage of original cost to charge to any one job. For some classes of work form lumber can be used more than ten times.

Concrete will not stick to forms that are oiled each time before use with a mixture of boiled linseed oil and kerosene, equal parts of each, but if not so oiled they should at least be thoroughly wetted down. They should be carefully cleaned of all particles of adhering concrete after

removal and be wet down immediately before again placing concrete in them.

Forms for the ordinary types of square or rectangular stock watering troughs, hog feeding troughs (Fig. 9), manure pits (Fig. 10), are all of a simple type, and when the earth is firm enough to be self-sustaining only an inside form will be necessary. Otherwise, form construction simply amounts to one frame within another; that is, two bottomless boxes of different sizes, one set inside of the other. Forms for square or rectangular tanks that are to be built above ground should provide for a batter or slope on the inside of the structure so that the expansion from freezing water will be spent upward instead of against the tank sides. Fig. 9 illustrates this. For such tanks as cisterns, which are usually placed wholly underground, of course a form is needed for the concrete roof or cover slab. This is in the nature of a floor supported by studs.

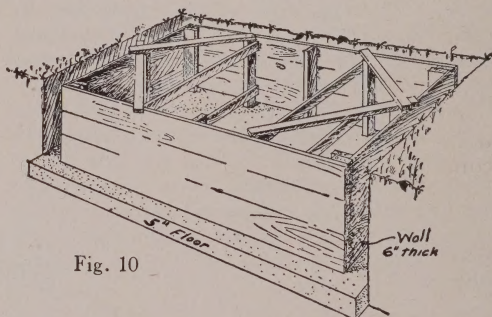


Fig. 10

Arrangements of forms for a manure pit

There is no possibility of stating with precision the time when forms may safely be removed from any piece of construction. This varies entirely with weather conditions and the mass of concrete. Whenever the structure is one which need support no weight but its own, such as a building wall of medium dimensions, all above ground, forms can sometimes be removed in three or four days. There is no advantage, however, in removing forms too early because the forms afford desirable protection to the concrete in preventing it from drying out too rapidly and also prevent a too rapid radiation of the chemical heat generated by the set of the cement. Forms for heavy arches, for

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floors supported above ground and roofs, must all be left in place from ten days to two, three or four weeks. It is a wise plan to leave forms in place a few days longer than may seem absolutely necessary, just to be on the safe side. Such a precaution often marks the difference between failure and success.

Reinforcing Concrete and Materials to Use

“Reinforcing” is the name given to the practice of embedding steel in concrete, to increase its strength against tension, or forces that tend to pull it apart. Concrete, like many building stones, is strong in compression; that is, in bearing loads which are placed directly upon it, but is relatively weak in tension; that is, in resisting forces which tend to pull it apart.

The materials usually employed to reinforce concrete are steel rods of various

inforce concrete, there are many difficulties and uncertainties attending their use. This is particularly true of barbed wire. The material is very difficult to place and to keep in proper place while depositing concrete, and unless reinforcing is placed and held in correct position while concrete is being deposited, a great deal of its possible effectiveness is lost.

If wires are to be substituted for the steel rods recommended, then one should be certain that the quantity of wires used equals in cross-sectional area the amount of rods for which substituted. The same holds true of using mesh fabric in place of rods. Mesh fabric is generally used instead of rods for floor, roof and pavement reinforcing.

On concrete work that has been the subject of engineering design only one general grade of reinforcing steel is considered. This can be obtained from any of the steel companies or through local building materials dealers.

Without going into details as to the physical and chemical properties of steel, it is sufficient to say that steel varies greatly in character; some is very much like wrought iron, while some may be compared to cast iron. In other words, one kind

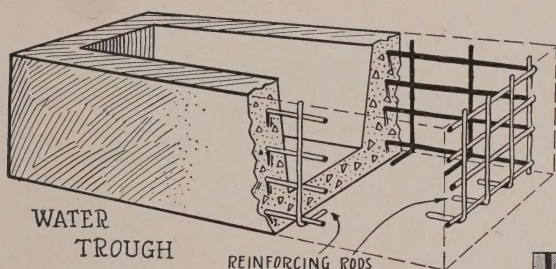


Fig. 11

forms, and woven mesh fabric similar to some of the common types of wire fencing. The reason for this is that specification requirements governing the practice of reinforcing concrete call for steel that possesses certain chemical and other qualities. Perhaps by far the commonest kind of reinforcing used is plain round or square or twisted square bars.

There are several types of so-called deformed bars to be had, many of which are patented, and therefore including in their price, royalty for the patentee. Deformed bars give a better mechanical bond between steel and concrete. However, in common types of construction, the other types of bars will answer when used with a quaky concrete mixture.

While it is possible to use old barbed wire and other waste materials to re-

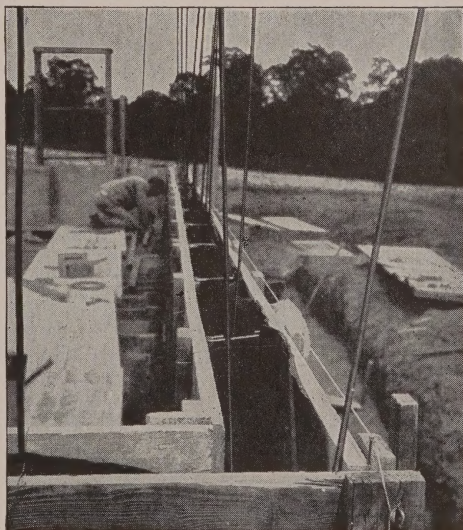


Fig. 12

Reinforcing bars as placed in concrete walls

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stretches and bends easily while the other is stiff and brittle. This should lead one to realize that not all steel is equally well suited for reinforcing concrete.

Regardless of whether plain round or square, twisted-square or deformed bars are used, the steel should meet what are known as the "Standard Specifications for Steel Reinforcing Bars," of the American Society for Testing Materials. Practically all of the steel companies manufacture reinforcing steel that meets these specifications.

In estimating for reinforcing steel it is best to increase the estimate by 10 per cent. over the actual amount calculated for, to cover shortage resulting from cutting.

The cost of steel in place exclusive of profit on a job is generally figured at a price varying from 3 to 4 cents per pound.

Reinforcing steel not only strengthens concrete against tension but in many cases makes possible the attainment of a required strength in a structure with considerable economy of concrete. It also serves to prevent cracks that may otherwise result from expansion and contraction under temperature changes. The principal reason for using steel instead of other metals is that the ratio of expansion of steel under temperature changes is so nearly like that of concrete that the two expand in a practically equal degree; therefore, there is no "breaking of bond" between the concrete and steel.

Reinforcing is particularly necessary in tanks or troughs, where freezing is likely to increase pressure. Foundations rarely need reinforcing. Building walls above ground usually do. Note Fig. 12.

The subject of reinforced concrete is a technical one and cannot be touched upon from the standpoint of design. Reinforcing for any structure should not be chosen by guess, although it is possible to specify in an offhand way safe practice for small structures such as the usual barnyard watering tanks or troughs, feeding-troughs etc. Usually $\frac{1}{4}$ -inch or $\frac{3}{8}$ -inch rods are used in tanks that are not greater than 2 by 8 feet inside dimensions, and are spaced from 6 to 12 inches center to center, both vertically and horizontally throughout the structure. See Fig. 11.

In reinforcing concrete the quantity of steel required in a structure may vary from $\frac{1}{2}$ to perhaps $1\frac{1}{2}$ per cent. of the cross-sectional area of the concrete. Columns and beams under excessive loads require as much as 4 per cent. or more of steel. These figures are of course only general and may vary considerably in individual cases.

Steel used for concrete reinforcement should be free from rust in the form of loose scale that would prevent the concrete from bonding properly with it. To be safe it should be brushed with a wire brush. Sometimes it is necessary to put the metal in a pickling bath, usually made

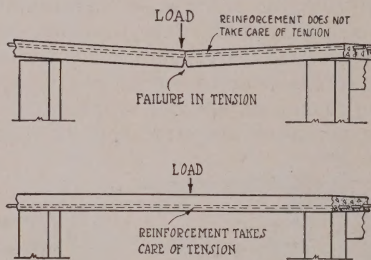


Fig. 13

by combining one part of sulphuric acid and five or six parts of water, and left there long enough to remove the rust. The rods should be thoroughly washed in clean water to prevent any further action on the steel.

There are a number of patented types of deformed sheet metal marketed under various proprietary names used particularly in floor, roof-slab and partition construction, which in some cases serve as forms as well as reinforcing.

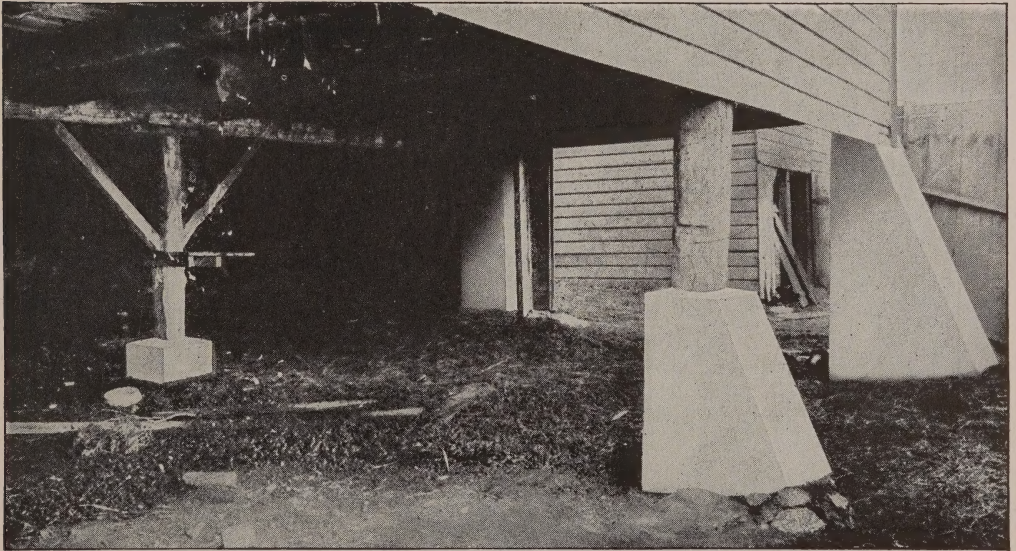
Before depositing concrete all reinforcing rods should be fixed in proper position so they will not become displaced while placing concrete. This is particularly important for construction that must be fire-safe, since it is necessary that the metal have the benefit of a certain amount of concrete covering, not only to prevent the steel from being exposed but to insure effective bond. Reinforcing rods in such a structure as a tank, a silo or a cistern, for instance, should be wired together where verticals and horizontals cross.

In splicing reinforcing it should be lapped from 50 to 60 times its diameter.

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This method of joining is more effective as a rule than bending ends and hooking them together, since there is certain to be some slack where rods are so hooked, and if a strain is brought upon the concrete at such a place in the structure then the reinforcing is not effective in resisting tension. A $\frac{1}{4}$ -inch rod should, therefore, be lapped with the rod which it joins not less than 12 and preferably 15 inches. Rods should be bound firmly together with wire wound around the lap. Patented "collar" clamps are also used. All rods used in beams and in floor and roof slabs should have the ends turned to an L-shaped loop or hook to form an anchor in the concrete. There should be at least 1 inch of concrete between the rods and the forms and never less than 2 inches between parallel rods.

When bending rods, bends should be made slowly. Force applied to the cold bar suddenly is quite likely to break it at the point of bending. Examine all bends and angles after made for cracks so as to detect any imperfections before placing the steel in the concrete. Reinforcing rods that are left projecting out of newly deposited concrete for the purpose of splicing other rods to them when work may be resumed should be protected against being struck or jarred, thus breaking the bond between the steel and the concrete. Reinforced concrete failures have resulted from the metal becoming misplaced while placing concrete. It is, therefore, essential that steel be placed exactly as called for in the plans. Note Fig. 13, illustrating correct and incorrect placing of reinforcement.



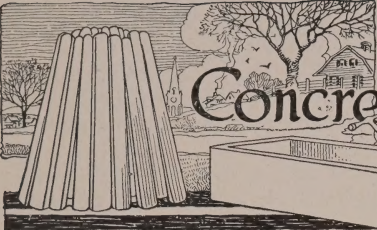
Repairing Foundations. A frequent cause of expense with frame structures is the necessity for repairing foundations because of failure of masonry or the rotting of sills and posts. Such repairs can be made of concrete so that the work once done is done forever. To do work of this character it is usually necessary to jack up the building slightly. Rotted portions of posts are sawed off, then a form is built so that the concrete when smoothed off will almost touch the end of the sawed-off posts and after the concrete has hardened the jacks can be lowered and the building allowed to rest on the concrete piers. (See illustration above.)



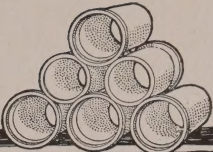
The New York Aqueduct
 (The Greatest Water Tube in the World)

THIS, the most notable aqueduct ever built, is 111 miles long, with a diameter up to 17 feet. In places it runs 1,100 feet below the surface. It is subjected to a pressure as high as 90,000 pounds per square foot and delivers up to five hundred million gallons a day. Constructed on such a stupendous scale, this great water tube is expected to supply the needs of the metropolis for generations.

Such an undertaking demanded the most dependable materials, as well as the highest engineering skill. That more than four and a half million bags of ALPHA were used in this huge aqueduct is a significant tribute to the uniformly high quality of ALPHA—the Guaranteed Portland Cement.



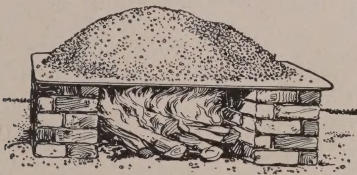
Concreting in Cold Weather



A GREAT deal of concrete work can be undertaken as well in winter as at other seasons. Indeed there is often more time and a lower labor cost in winter than during the summer. Posts, drain pipes, rollers, slabs, watering troughs, tanks, floors, etc., can be completed indoors, and—with the exception of floors—the finished work can be put into place outside later. Such work can be done in barns, sheds, basements, etc.

All winter concrete work must be done with extreme care. There must be established, through artificial means, the conditions that make for good work during favorable seasons of the year. For very large undertakings considerable equipment is necessary. For small jobs and moderately cold weather the equipment is simple and inexpensive.

There are various methods of protecting concrete in freezing weather. These include the heating of the materials and water to a temperature not higher than 145° F., and protection of the concrete until it is no longer in danger of disintegration through the action of frost.



Heating Sand

Common salt has been used in mixing water to prevent freezing of concrete when freshly deposited. But it has been found merely to lower the freezing point of the water and to cause the concrete to harden more slowly. The amount of salt used is generally one per cent. of the weight of the water for each degree of temperature below freezing point to be counteracted. And since not more than 10 per cent. can safely be used without probability of impairing the strength of

concrete, salt affords protection only for temperature above 22 degrees—10 degrees below freezing. One and one-half pounds of salt to 18 gallons of the mixing water is a proportion used generally. Experiments indicate that salt in reinforcing concrete corrodes the steel and is therefore objectionable.

Salt should not be used if efflorescence on the surface of the finished work is objectionable.

The method of heating materials is the better practice where this can be carried out. Half-cylinders of sheet steel set on the ground in the form of an arch are used for heating sand and stone, and also metal culvert pipe and pipe coils supplied with steam. Another simple and practical method of heating is illustrated on this page.

Where steam is used, the sand and stone may be heated by piling them directly on the pipe coils or by covering the material with tarpaulins and applying the steam directly to the materials. Short pieces of iron pipe attached to the boiler by lengths of hose are often stuck into the piles of material at points desired, thus allowing the steam to escape through the materials. This is regarded as a good method in that it avoids the rehandling of the materials.

Where sand heaters are used, precautions must be taken not to overheat or damage the material in direct contact with the heater. Some stone will crumble if exposed to intense heat. The cement, being only a small part of the mass of concrete, need not be heated.

Mixing water may be heated by placing a steam pipe in the water barrel, or by providing a suitable tank with a steam coil or a fire in a furnace underneath.

To make sure that the concrete goes into the work unchilled by cold weather, live steam is often kept in the drum of the mixer, the openings being covered with canvas flaps.

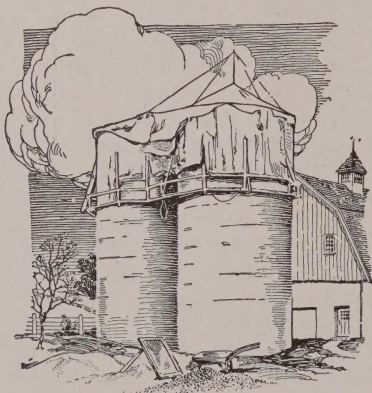
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In conveying concrete a considerable distance from mixer to the construction, a cupful of gasoline poured into the empty concrete car on its return trip and lighted, has been known to keep the fresh batch from being chilled.

Small stoves filled with coke and kept sufficiently warm to prevent freezing, may be used for heating buildings during the process of construction. To make them efficient, the work must be housed or covered with canvas to prevent the escape of the heat created by the stoves.

The protection of fresh concrete is treated on pages 18 and 22.

Since freezing temperatures materially retard the hardening of concrete and injury is likely to result, it is obvious that precautions should be taken to enable the fresh concrete to acquire strength rapidly. To insure that concrete will have sufficient heat to assist in hastening early hardening, materials and water should be heated so that the concrete when deposited will have a temperature not lower than 80 degrees Fahrenheit.



Note open stove under canvas flap

Plain mass work, such as retaining walls and abutments, will not require the same care and protection as thin walls, columns, beams and floor slabs.

Claims are sometimes made that concrete frozen before hardening may not suffer permanent injury if upon thawing it is not again exposed to freezing weather until sufficiently hardened to be unaffected by such exposure. Nevertheless every precaution should be taken to pre-

vent freezing. If this is guarded against for at least five days, the danger of injury from subsequent freezing may be assumed to have passed.

Properly hardened concrete and frozen concrete look much alike. For this reason extreme care must be taken about removing forms from concrete that has been exposed to freezing weather. Forms must be left in place until the concrete has obtained sufficient strength to be self-supporting or to support imposed loads. If the surface becomes soft after application of hot water, this is good evidence that the concrete is frozen.

Fireproofing

No other structural material has given such a good account of itself when exposed to severe fire tests as concrete. It will not burn and is a slow conductor of heat.

Suitable Aggregates. For highest fire resistance aggregates should be selected with a view to their fire-resisting properties. Sand should be siliceous, while the coarse aggregates should be trap rock or slag or where great strength is not required, clean cinders. Trap rock, being of volcanic origin, was at one time in nature subjected to extreme heat, hence is well able to resist long and severe exposure to fire. In addition, it is a very tough rock and produces strong concrete.

Cinders are often used as an aggregate in concrete when great strength is not required, yet good resistance to fire is desirable. They must be free from ash and particularly from particles of unburned coal. The latter upon exposure to fire would, of course, not be fire-resisting and their burning taking place in the concrete, would cause its disintegration.

Unsuitable Aggregates. Marbles, granites, limestones, dolomites or magnesium limestones, and some gravels containing lime and magnesium will not withstand intense heat but break down. So where fire resistance is desired such materials should not be used as coarse aggregate.

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Scarcity of timber in large sizes has resulted in a rapid advance in price of such material within late years and this has brought about a situation whereby absolutely fire-safe concrete buildings can be built for the same cost or at least little greater cost than required for buildings that are thoroughly combustible.

Protection of Reinforcement. In all fireproof construction it is very necessary that reinforcing be held in proper position while concrete is placed so the steel will have a sufficient protective covering to prevent heat from warping or melting it. As a general rule reinforcing steel in floor slabs should be protected by not less than a 1-inch covering of concrete, in beams by not less than $1\frac{1}{2}$ inches, and in columns by not less than 2 inches.

Chimney Work. Concrete is used largely and very successfully in chimney construction and no doubt in many cases the heat where the gases enter the chimney is 1000 degrees Fahrenheit. Even under continued exposure to the high temperatures of severe fires, the surface of exposed concrete does not soften to a depth exceeding one inch and usually very much less in ordinary fires, perhaps less than one-quarter of an inch. This softening action is due to the loss of the water of crystallization; in other words, the cement becomes dehydrated. However, this softened layer acts as a protection because it transmits heat slowly, and many tests have shown that the interior of the mass is not heated to a sufficient degree to cause the slightest injury.

Concrete in Great Fires. The San Francisco and Baltimore fires have both become historical. In each of these cases concrete buildings were about the only ones that suffered no great harm. Among the latest of great demonstrations of concrete's fire-resisting qualities was the Edison fire at Orange, N. J. In this case all buildings except those of concrete, that were exposed to the ravages of this fire, were a total loss, while the concrete buildings suffered relatively little damage and were restored to full usefulness in a short time at small expense.

Making Concrete Watertight

The fact that there has been much porous concrete made has led to the marketing of various compounds intended to increase the watertightness of concrete. While many, if not all of these compounds accomplish temporarily at least the purpose intended, none of them is essential to securing watertight concrete construction. The fundamentals of watertight concrete are contained in the chapter devoted to "Materials, Proportioning, Mixing and Placing." If properly graded materials are used a 1:2:4 or 1:2½:4 mixture will produce watertight concrete against the passage of water. If a head or pressure of water is to be resisted a 1:2:3 mixture will answer.

Density By Proper Grading of Aggregates. Proportioning concrete for maximum density, hence for watertightness, depends upon using well-graded pebbles or broken stone and sand, enough sand being used to fill the air spaces existing in the coarse aggregate; finally, using enough cement to fill the voids which remain in the combined sand and pebbles. Many of the proprietary preparations commonly referred to as integral compounds are of questionable composition and none of them has been in use long enough as yet for one to say positively that the results obtained by their use will be permanent or that the composition of some of them is such as not to be injurious to the concrete.

Some of the earliest experiments toward increasing the watertightness of concrete consisted of adding a small amount of clay to the other materials. But as any quantity of clay over a very small percentage affects the strength of concrete and as it is not possible to add clay out on the job in the same manner that it is added when making laboratory experiments, such a practice is questionable.

Hydrated lime, often added to concrete mixtures, acts only as a void filler. The danger in it is that too much lime may be used, affecting the strength of the concrete. A little more cement instead

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of lime, would serve the purpose without the same danger.

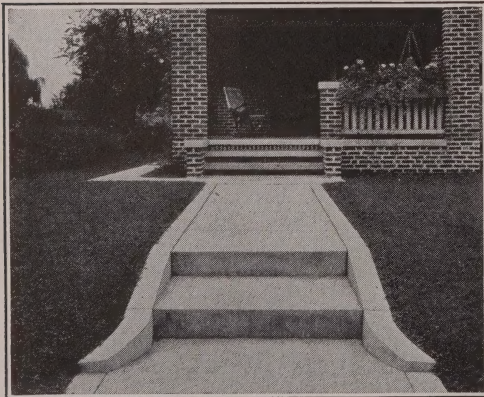
The use of integral compound is apt to encourage careless proportioning and placing, with the idea that the use of the additional materials or compounds will make good the lack of carefulness.

Bureau of Standards Test. As to the use of integral compounds in concrete, the following paragraphs tell in part the results of tests made under the direction of the Bureau of Standards at Washington. They are taken from the summary from some of these tests reported in Technologic papers No. 3, Bureau of Standards.

"The addition of so-called waterproofing compounds will not compensate for lean mixtures, nor for poor materials, nor for poor workmanship in the fabrication of concrete, since, in practice, the inert integral compounds (acting simply as void filling material) are added in such small quantities they have very little or no effect on the permeability of the concrete. If the same care be taken in making the concrete impermeable without the addition of waterproofing, as is ordinarily taken when waterproofing materials are added, an impermeable concrete can be obtained."

In another paragraph of this report is the following:

"In order to obtain such impermeable mortar or concrete considerable care should be exercised in selecting good materials as aggregates and proportioning them in such a manner as to obtain a dense mixture. The consistency of the mixture should be wet enough so that it can be puddled, the particles flowing into position without tamping. The mixture should be well spaded in the forms when placed so as to avoid the formation of pockets on the surface."



Good design for a low terrace

Some Commonly Used Methods. Integral compounds that are not in the nature of void fillers combine with free chemical salts in the concrete to form insoluble compounds. Such preparations frequently contain sodium silicate, commonly known as water glass. In fact, such a preparation is useful when porous concrete must be treated to make it watertight. One part of the chemical dissolved in 3, 4 or 5 parts of water and applied as a paint at intervals of 24 hours will eventually fill the pores and render the surface watertight. Usually two or more applications are required, depending upon the porosity of the concrete. Another treatment known as Sylvester's treatment, which consists of separate soap and alum solutions, acts in a similar manner.

A formula that has been used generally is the following: Dissolve five pounds of powdered alum and one pound of lye in ten quarts of water. Use $\frac{1}{2}$ pint of this mixture in every bucketful of water used in mixing the cement. For an outside waterproof wash, add $\frac{1}{2}$ pint of this mixture to a bucket of water and thicken to a heavy wash with pure cement.

Result of Rapid Drying Out. Even though concrete may have been properly proportioned, mixed and placed, the mass may be porous as a result of allowing it to dry out too rapidly. The remedy is to leave forms in place and protect it as suggested elsewhere under the title "Protection of Fresh Concrete." (Pages 18 and 22.)

Leaks in tanks, troughs, cisterns and similar structures sometimes result from the fact that no precautions were taken to join correctly the concreting of different days' work. When concreting is stopped the surface in the forms should be left rough so that there will be an opportunity for the concrete placed the following day to bond to the old concrete. The surface should be well washed, and painted with a cement grout paint mixed to the consistency of cream, applied immediately before placing new concrete. Some contractors when discontinuing work on tanks, silos and troughs, embed a 6 or 8-inch strip of tin or thin stovepipe iron

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into the concrete, leaving half of it to project in the concrete to be deposited the next day, also painting the surface with a cement grout paint immediately preceding the placing of fresh concrete. This has been found to be a very effective method of preventing construction joints from opening up.

Concrete Block and Brick

Within the last two or three years there has taken place a remarkable change in concrete block architecture. Various kinds of facing mixtures are now being used, and give under proper treatment a surface finish resembling granite or a number of other stone textures that makes a striking appeal to builders. The day of the old imitation stone face attempted by use of a fantastic facing plate in the block machine is passing. Certainly, block construction formed of units that presented a monotony which this old practice displayed was far from pleasing. If concrete block and brick are properly made, no trouble will be encountered from the entrance of water through a wall constructed of these units. However, in the case of concrete block, unless the type of block is such as to produce a wall having a continuous horizontal and vertical air space, the inside surface of the wall may be subject to sweating as variations of outside temperature occur, and it is unsafe to apply plaster directly to the block without furring and lathing. In this respect concrete block does not differ from other masonry construction which must either have continuous air space in the wall or continuous air space provided by furring the inside face of the wall to prevent moisture from reaching plastering and interior decoration.

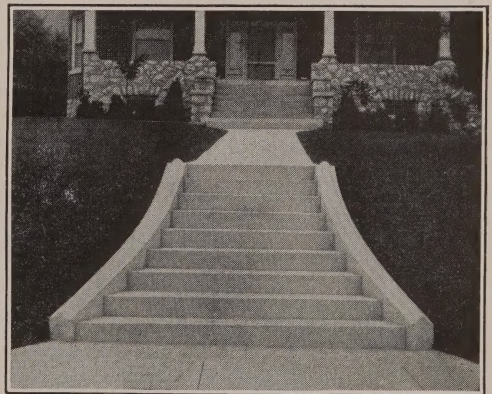
Rough cast concrete block form very desirable building units where it is intended finally to finish the exterior of a structure by applying a coat of stucco. Block buildings of this character may be erected at a cost which does not exceed a frame structure by more than 5 or 6 per cent. and a concrete block house is probably the lowest cost type of permanent fireproof building possible to construct.

Aggregates and Proportions. The revival of interest in concrete block comes not only with an improvement in its finish, but with a renewed regard for the essentials of concrete. As in all good concrete, block construction must not be undertaken with sand bank-run, pit-run, or river-run materials without screening and proper reportioning of fine and coarse contents.

The body of the block should be composed of a 1: $2\frac{1}{2}$: 4 mixture in which the $2\frac{1}{2}$ cubic feet of sand is represented by clean, coarse, well-graded material, varying in size from the smaller particles up to $\frac{1}{4}$ inch, while the 4 cubic feet representing the pebbles or broken stone must be material uniformly graded from $\frac{1}{4}$ up to $\frac{3}{4}$ or 1 inch. To hope for best results from a mixture consisting of 1 part of cement to 4 cubic feet of sand is useless.

When concrete block is to be faced with a richer mixture in which a selected aggregate is used, proportions may be either 1 sack of cement to $1\frac{1}{2}$ cubic feet of aggregate or 1 sack of cement to 2 cubic feet of aggregate, depending upon the grading of material used in the facing mixture and the surface texture desired.

Amount of Water. Consistency, which means the amount of water used in the concrete, is a very important consideration in block manufacture. Failure to appreciate its importance has in the past perhaps done as much as any other one thing to cast disfavor on concrete block construction. Manufacturers have attempted to increase their output by using



A graceful design

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less water than is required for the proper hardening of the concrete because the drier the mixture within certain limits the sooner they could remove the block from the mold and the greater number of blocks they could make within a given time.

Regardless of whether the type of mold used is one dependent on hand tamping or power pressure, enough water must be used to cause a slight flushing of water to the surface when compacting the concrete. Concrete will not stick to the mold if the face plates are thoroughly wiped each time after removing a block and then given a coating of kerosene before again filling with concrete.

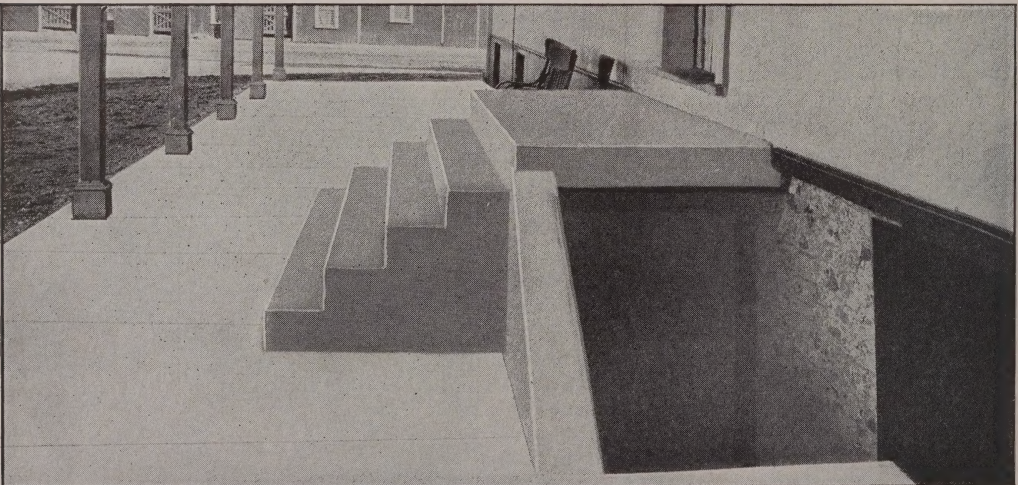
Curing of Blocks. Properly graded mixtures, mixtures of proper consistency and proper curing insure watertightness. Perhaps curing or hardening is the step in manufacture most frequently slighted, yet ultimate success depends in an equal degree upon observing hardening requirements. As soon as possible after removing from the machine, blocks should be protected from sun, wind, etc. as suggested on page 18.

By far the best method of hardening concrete block, brick and similar concrete products is in a steam room. For this purpose steam should be admitted into the room through a perforated pipe, immersed in a trough of water on the floor

of the room, so that steam under pressure cannot come in contact with the fresh concrete. In this way the atmosphere in the hardening chamber is kept thoroughly moist and a temperature of 100 to 130 degrees may easily be maintained. Another advantage in steam hardening is that the hardening is more uniform and as much may be accomplished in 48 hours in the steam chamber as can be accomplished under other methods in a week or ten days.

Concrete Brick. Concrete brick is a good product to manufacture and can be made to compete with everything except common clay brick used for backing walls faced with facing brick. In making concrete brick, 1 sack of Portland Cement should be mixed with not more than 3 cubic feet of clean, coarse sand, and where desirable to face the brick with a richer material, 1 sack of Portland Cement should be mixed with 2 cubic feet of sand, granite screenings or other desirable facing material. While it has been customary to make the facing material somewhat drier than the body of the brick, this practice is not to be recommended.

If artificial colors are desired, the coloring matter must not exceed from 5 to 8 per cent. of the weight of the cement.



Concrete is used here for the porch floor, steps and cellar steps



Loring and Phipps, Architects

Concrete Houses

CONCRETE had to prove its merit by the test of time, before architects adopted it as a material for general building.

Fireproof. Probably its first claim to consideration for house construction, was its fireproofness. The annual loss by fire in the United States exceeds \$245,000,000. In suburban sections, where fire-fighting apparatus is inadequate, fireproof construction is the only safeguard.

With these facts in mind, and with the saving it makes possible in fire insurance, concrete steadily gained favor as a building material.

Strength and Permanence are the objects of present-day builders, and they choose materials accordingly. They select concrete because it has proven its ability to resist wind, flood and fire—because it grows stronger and harder each year.

Architectural Beauty in American residences is undergoing striking progress, since concrete came into general use as a building material. The frills and fuss of frame construction have given way to a simplicity that is classic and refined. This is notable even in residences of moderate cost.

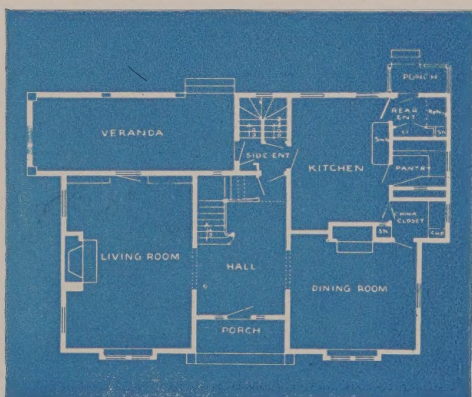
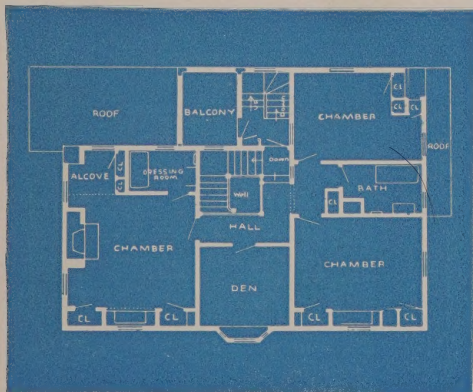
Concrete is adaptable to any sort of treatment. Moreover, it makes possible effects that cannot be secured with other material.

Economy is another of the chief considerations of concrete as a material for house construction. While lumber and labor have advanced considerably, the materials used in concrete have increased only a trifle in cost. Cost is influenced, of course, by size, design, local conditions, etc. But the following figures on cost of concrete construction will prove interesting:

In Muskogee, Oklahoma, 6-room concrete houses were built for \$1603.

In Arkansas City, Kansas, a concrete block wall house, 21 ft. x 35 ft. with 7 rooms and bath, pantry, 4 closets and cellar, cost complete \$1964.65. The block work cost \$312.14. 8 x 8 x 16 inch blocks were used.

In Rochester, New York, an 8-room hollow wall concrete house with bath and attic was built for \$1971.50 excluding cost of excavation. A frame house of the same dimensions built next to it cost \$219.10 more but sold for \$400 less and now rents for \$26 less per year.



ALPHA CEMENT — HOW TO USE IT



W. H. Parrish, Designer and Builder

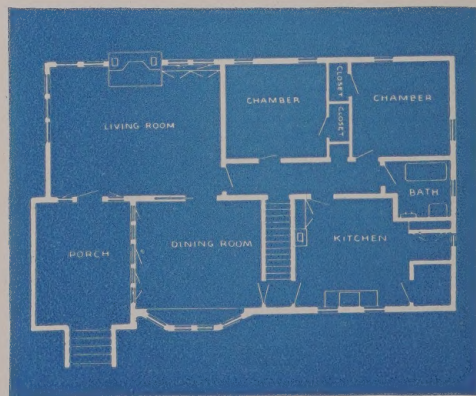
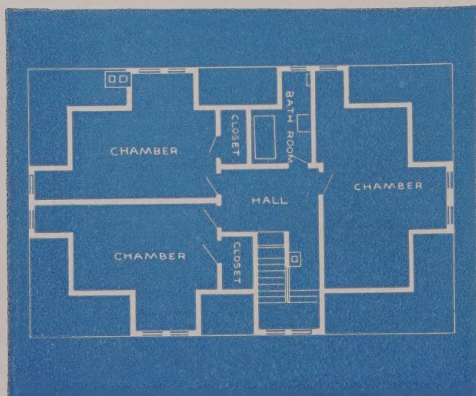
These figures represent first cost. Consider along with them, the fact that concrete lasts practically forever, that repairing and painting are unnecessary, and it is easy to see that a concrete house is far more economical. It costs less per year, every year.

Slow Conductivity of concrete means that it does not readily conduct the weather outdoors to the rooms indoors. On the hottest days, it is often 15 degrees cooler in a concrete house than outdoors. And experiments have shown a saving of 20% in heating concrete houses.

Sanitary features of concrete make it still more worthy of consideration. Solid walls and floors discourage dirt and vermin.

Kinds of Concrete Construction

There are many different types of concrete construction. The type best suited to the home builder's individual requirements is a matter that should be discussed with the architect.



Concrete Surface Finish

The usual run of concrete farm structures require no after-surface treatment if forms have been well constructed, but on a residence some surface treatment is desirable. Concrete may be treated with paint consisting of half cement and half sand mixed with water to a consistency about like cream. Before applying, the holes and irregularities should be pointed up before the surface has thoroughly hardened.

Concrete surfaces may be rubbed with carborundum stone, keeping the surface thoroughly wet and working the stone with a circular motion. Frequently concrete surfaces, both block and monolithic, are plastered or stuccoed with a 1:2 sand-cement mortar. If such a finish is to be applied to monolithic work, it is then best not to spade the concrete too much next to form faces when placing, as a surface with small pockets in it has a good key for the plaster coat. Among the common and effective methods of concrete surface treatment are scrubbing, treating with weak acid solutions, and bush-hammering.

Scrubbed Surfaces. Forms are removed just as soon as it is safe to do so without injury to the concrete and while the latter is still fresh. Scrubbing the surface with a stiff brush and water will remove the film of cement and expose the aggregates. If these have been selected with an eye to their pleasing color, this scrubbing process furnishes a very artistic finish.

Facing mixtures composed of selected aggregates are often used with this end in

ALPHA CEMENT — HOW TO USE IT

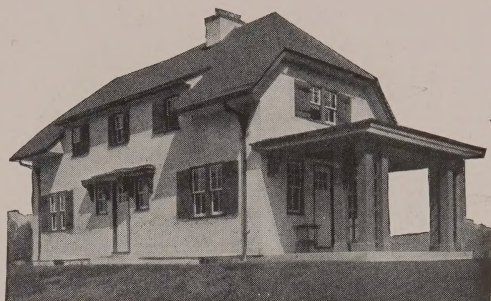
view, the facing mixture being placed by using a metal septum, or partition, set up in the forms an inch or more back of the form face. When facing a surface in this way with a special mixture, care should be taken to see that the body and surface mixtures are of the same consistency so the two will bond perfectly as the partition is withdrawn and the concrete tamped.

Acid Wash. Washing with an acid solution after forms have been removed, will also expose aggregates. Usually one part muriatic acid and three or four parts of water are employed. The surface must be washed down immediately after such a wash to remove all traces of the acid and prevent any further action.

Colored sands may be used in concrete mixtures where a surface is to be treated by the acid wash or scrubbing process. Garnet sands of reddish color may be had, or other colors may be made by adding lampblack and mineral pigments to sand. Mineral pigments will not fade.

Bush Hammering is a little more expensive treatment, but gives a very attractive surface. A hammer made for this purpose should be used to chip and roughen the surface of hardened concrete. Care should be exercised to prevent chipping away corners or dislodging large particles of concrete.

Removing White Discolorations. Mottled white markings on concrete surfaces (generally called efflorescence), are an indication of a porous surface. To prevent this, the concrete should be made dense. To remove it and prevent its reappearance, the surface should be



Norman Biard Baker, Architect

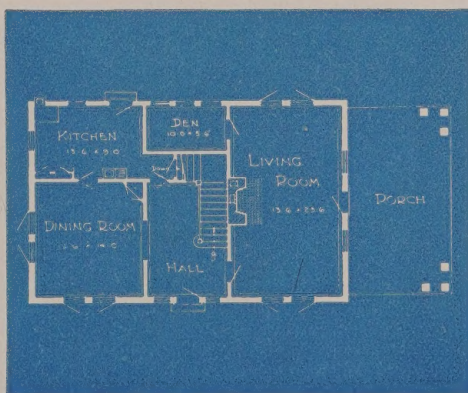
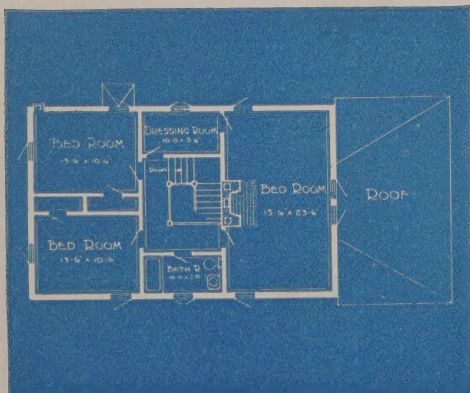
scrubbed down quickly with a very weak muriatic acid solution.

Overcoming Porosity. After removing the markings with the acid solution, paint the surface with a boiling hot mixture of three-quarters of a pound of common laundry soap in one gallon of water. Twenty-four hours later, paint with a solution of two ounces of alum in a gallon of water of ordinary temperature. Repeat this after twenty-four hours more, and the surface should be practically impervious.

Portland Cement Stucco

Stucco is a mixture of Portland cement, sand and hydrated lime, combined with water so as to form a plaster or mortar that can readily be applied by means of a trowel in the same manner as interior walls are plastered. This material is coming into greater use every day as an exterior finish for buildings of frame construction and for renovating old buildings whether of frame or masonry construction.

Stucco does not make a building fire-proof, but it does give fire protection. It



ALPHA CEMENT — HOW TO USE IT



Chatham Real Estate and Improvement Co., Savannah, Ga.

preserves frame buildings against decay, making painting and repairs unnecessary. Stucco furnishes protection against changeable weather and makes a building easier to heat. It is watertight, making a building damp-proof.

Lathing and Trim. Before applying stucco it is necessary to furr-and-lath the exterior of a frame structure. Furring strips 1 by 2 inches should be nailed to the wall vertically, at distances apart corresponding to the studs in the building. Wood lath, metal lath or some metal fabric is then fastened to the strips in practically the same manner as an interior wall is prepared for plastering. When the old weather boarding is left in place all old trim should be brought out flush with the finished wall surface or made to project beyond it.

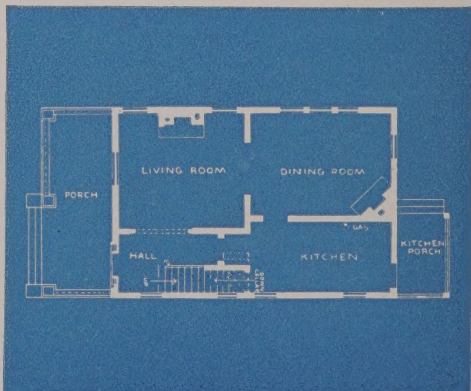
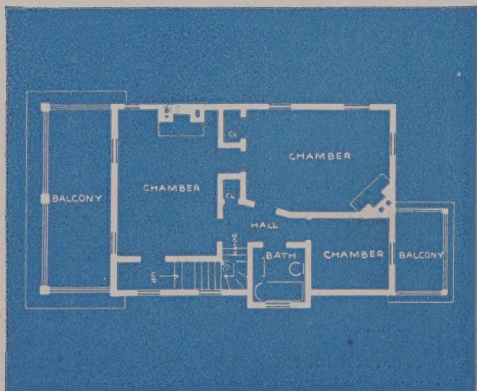
The sand used in the stucco mixture must be very carefully graded so that all

particles will be perfectly coated with cement, all voids in the sand filled, and the plaster coat thus made dense and watertight.

Number of Coats. As a rule two coats of plaster are used in stucco work unless some particular final finish is desired, when a third coat is applied. The first, or scratch coat as it is called, is generally composed of two parts of clean well-graded sand to one part of cement, with hydrated lime added in an amount equal to 10 per cent. of the cement. Often a small quantity of cow hair is added to the mixture for the first coat to give greater bond or key with the lath. This coat should be from $\frac{3}{8}$ - to $\frac{1}{2}$ -inch thick, and before it has become hard it should be scratched with some kind of a tool having saw toothed edge so that the surface will be roughened to form a good bond for the next coat.

Preparation of Lime. If hydrated lime cannot be obtained, ordinary lump lime may be slacked and used. In this case good quicklime should be slacked in an excess of water, at least two weeks previous to being used. A day or two before commencing the work the lime should be thinned with water and strained through a fine sieve to remove any un-slacked particles. This should be allowed to settle and form a putty and then mixed with sand to form a sand-lime mortar to which cement is added immediately before use.

Working Methods. Sand-lime mortar may be mixed in large quantities at a



ALPHA CEMENT — HOW TO USE IT

time, but cement should be added only to a quantity that could be used in the next half hour. This prevents the plaster from hardening before it is used. Addition of lime to cement-plaster "fattens" the mortar so that it works easier under the float. The final mixture should be wet enough to work easily but stiff enough to prevent any flowing after it is applied to the wall. Plaster must be forced well into the meshes of metal lath, expanded metal or wire mesh to form a good key. If metal lath or wire mesh is used a small mesh is preferable, as the plaster dropping through a large mesh would result in considerable waste. Just enough trowelling should be given to force the plaster into the meshes and to bring it to $\frac{1}{2}$ -inch thickness. As soon as the first coat is hard enough to support another, the second coat is applied and scratched to form a bond with the third coat which is applied as soon as the second coat is strong enough to support it. Each coat should be thoroughly wet immediately before following coat is applied. When wood lath is used, it should be well wet before plastering to prevent its absorbing much water from the cement-plaster.

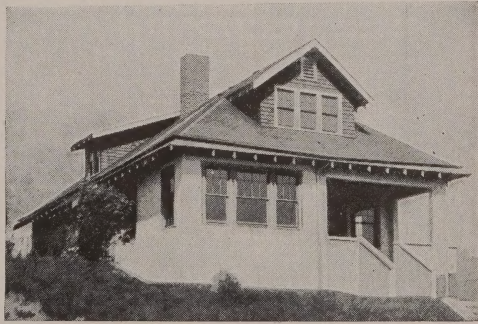
In new buildings to be finished with stucco, the methods of construction are influenced somewhat by climatic and other local conditions. Usually 2 x 6 wall studs is preferable to 2 x 4. Place studs 16 inches center to center, bridged every 4 or 5 feet. First cover the outside with $\frac{3}{4}$ -inch sheathing boards, not too close to each other and well nailed. Then put on two thicknesses of roofing paper held by furring strips nailed over the studs. On these strips fasten expanded metal lath. The wall is then ready for the

stucco. By this method the builder can complete the interior of the structure and do all hammering and pounding necessary while the wood is shrinking and the house settling. This will eliminate the danger of cracking the stucco coat, and do away with outside wood finish at doors and windows, so that the final finish may be treated as any other permanent construction. Cement plaster properly proportioned and applied is an absolute protection for the metal lath against deterioration from rust.

Pebble Dash Surface. Clean pebbles of uniform size, mixed in a thin cement-water paint and then immediately thrown against a freshly plastered surface, gives a very attractive appearance to a stucco exterior. A similar surface may be obtained by mixing cement and lime paste to the consistency of thick cream and then adding 1 part of washed pebbles to 5 parts of the mixture. This may be applied with a trowel or dashed against the wall with 6-inch-wide wood paddle.

Broom Dash Finish. A mixture of 1 part of ALPHA Portland CEMENT, one-tenth part hydrated lime, and 1 part of fine white sand, mixed dry to an even color, with enough water to give creamy consistency may be thrown with a whisk broom against a dampened wall.

Colored Effects in Portland cement stucco may be secured by the use of mineral pigments. While most colors will fade somewhat in time, blacks are generally classed as safe, the carbon blacks being preferable to lampblack.

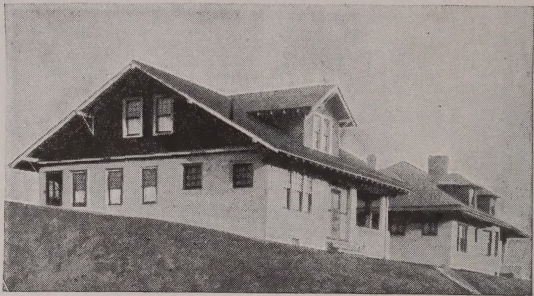


ALPHA CEMENT — HOW TO USE IT

Some Further Hints. For a smooth finish, the final coat should be evenly trowelled. White sand used in cement stucco containing lime putty or hydrated lime, will give a light finish. A trowel covered with carpet or burlap will give a roughened finish. The surface should be trowelled rapidly as the plaster is likely to crack and fall off if disturbed after the cement has begun to harden. Use a little more sand and a little less water than usual, for best results. Use large grained sand for rough finish. For slap-dash finish, throw the final coat against the wall with a wood paddle. It takes experience to make slap-dash even and regular.

Weather Conditions. Portland cement plaster frozen before it has hardened will be ruined. Freezing after it has hardened will not injure it. Stucco should be protected just like fresh concrete. (See page 18.)

Stucco on Brick or Masonry. The surface must first be thoroughly scrubbed with brush and water. If it had been painted previously, the paint should be removed before scrubbing. Immediately before applying stucco the surface should be saturated with water to prevent it from absorbing moisture from the plaster.



Mortar joints should be picked back so as to provide a better bond between wall and plaster. Plastering should be started at the top of the wall and continued downward. The work should be done continuously. The materials should be measured carefully for every batch of plaster to insure uniform color.

If preferred, a brick or masonry surface may be furred and treated like a frame structure.

Mr. W. H. Parrish, Carnegie, Pa., designer and builder of the dwellings illustrated above and on pages 34 and 37, says, "The cost is little more than for good frame construction. Concrete houses not only look well but can be heated for less money. They are sanitary, everlasting and absolutely fireproof."

TABLE OF COLORS TO BE USED IN PORTLAND CEMENT

COLOR DESIRED	COMMERCIAL NAMES OF COLORS FOR USE IN CEMENT	POUNDS OF COLOR REQUIRED FOR EACH BAG OF CEMENT TO SECURE—	
		Light Shade	Medium Shade
Grays, blue-black and black	{ Germantown lampblack Carbon black Black oxide of manganese	$\frac{1}{2}$ $\frac{1}{2}$ 1	1 1 2
Blue shade	Ultramarine blue	5	10
Brownish-red to dull brick-red	Red oxide of iron	5	10
Bright red to vermilion	Mineral turkey red	5	10
Red sandstone to purplish-red	Indian red	5	10
Brown to reddish-brown	Metallic brown (oxide)	5	10
Buff, colonial, tint and yellow	Yellow ochre	5	10
Green shade	Chromium oxide	5	10

ALPHA CEMENT — HOW TO USE IT

An Economical Method of Constructing Concrete Walls of a House

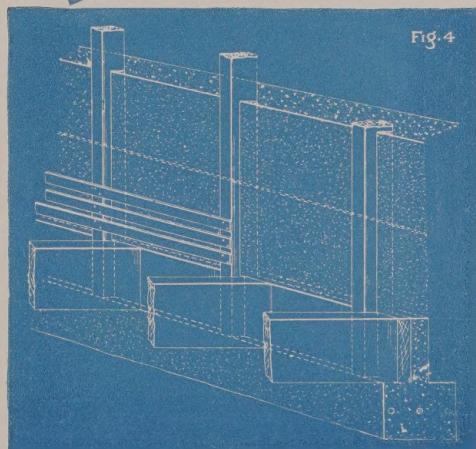
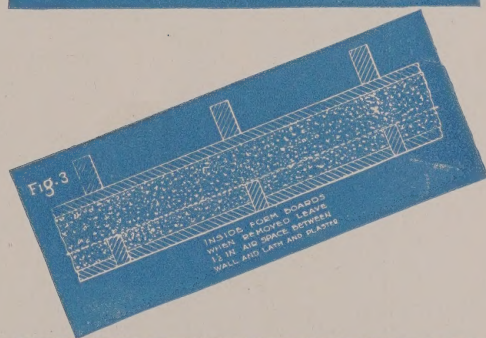
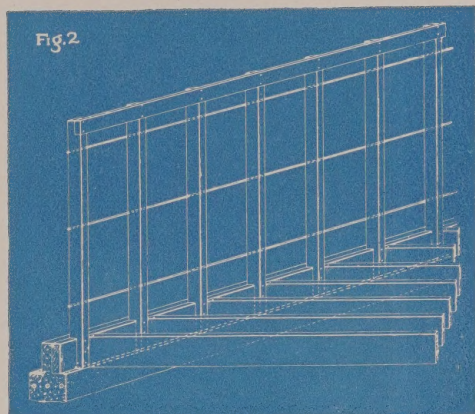
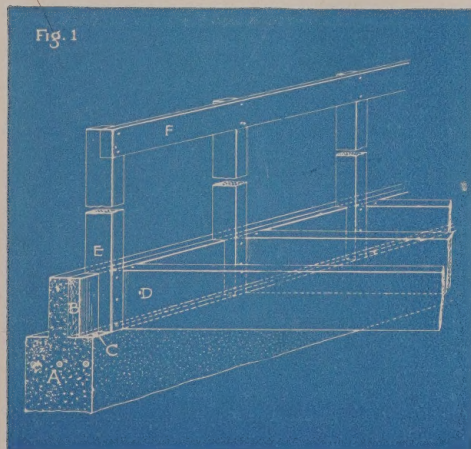
The blue prints on this page illustrate a type of wall construction that is simple, efficient and economical.

Building the Frame. In Fig. 1, the reinforced concrete girder (a) surmounts the foundation wall. A 2 x 10 sill (b) is placed on edge against the inside of the projection at the top of the girder and rests on the shelf (c). The joist (d) rests on the shelf (c) and is spiked to the sill (b). The 2 x 4 stud (e) is halved 10 inches and spiked to the sill (b). The stud is also halved at the top and the 2 x 4 plate (f) set on edge flush with the inside of the stud.

Reinforcing. When the frame for the house has been completed three $\frac{1}{4}$ -inch wires equal distances apart are run horizontally around the outside of the studding (See Fig. 2). These wires are fastened to the studs with 2-inch staples.

Forms. Fig. 3 shows the forms ready to receive the concrete. $1\frac{1}{2}$ -inch material is used for the inside forms and it is placed between the studding flush with the inside of the studs. While this material is cut in such a way that the lumber cannot likely be used for other purposes, if a number of walls are built on the plan here indicated, the forms can be used repeatedly. The outside form is held in position by wires passed around 2 x 4 or 3 x 4 form uprights and tied to the studding. See also page 19 for further information on forms and reinforcing.

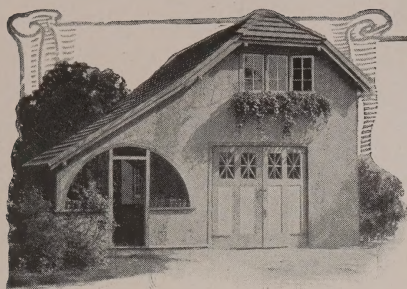
Air Space. After the concrete has been poured and allowed to set, the forms are removed. When the inside forms are taken out a $1\frac{1}{2}$ -inch air space is left between the inside of the concrete wall and the lath and plaster. See Fig. 4. The studs are firmly imbedded in the concrete and the wire reinforcement is near the center of the wall.





Naval Academy Armory
(Annapolis, Maryland)

THE impressive appearance of this Government structure is the result of the architect's efforts to make the building symbolize the strength of the United States Navy. The severe architectural treatment—the impressive arched entrance—the massive block construction—all suggest strength and permanence. The materials used in the construction of this building, as in all Government work, were required to meet exacting tests. The engineers who were responsible for the quality of the work used ALPHA, the Guaranteed Portland Cement.

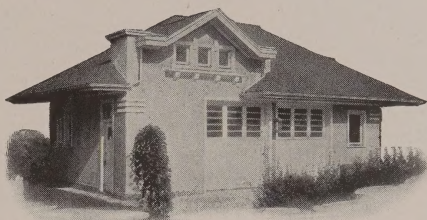


Building a concrete Garage

THE owner of an automobile demands more than a mere housing. He aims to have a building that is distinctive in design, fireproof, durable and equipped to make the necessary work on the automobile easier.

The logical location for the garage is at the rear of the house. This is a point, however, that can be discussed only generally, as the individual requirements may make it necessary to have the garage elsewhere on the property.

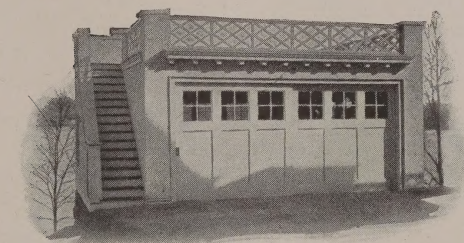
In deciding upon the size of the garage, future possible requirements should be anticipated. Even where it is fairly certain that there will never be more than one automobile, it is often a good idea to make accommodations for two. There is then room for visitors' automobiles or half of the garage may be rented to a neighbor.



proof qualities in hundreds of notable instances. Insurance companies give lower rates on property protected by concrete. A concrete garage is easily and cheaply built, is permanently attractive, and is everlasting. It is dry at all times—and is warm in winter and cool in summer. It is clean and easy to keep clean. It is economical because it eliminates the necessity of painting and repairs.

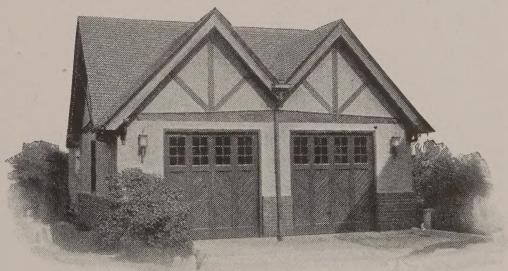
The photographs reproduced here show some pleasing effects in garage construction secured by the use of concrete. The blue-prints on the succeeding pages suggest attractive designs for inexpensive types of one-car and two-car garages.

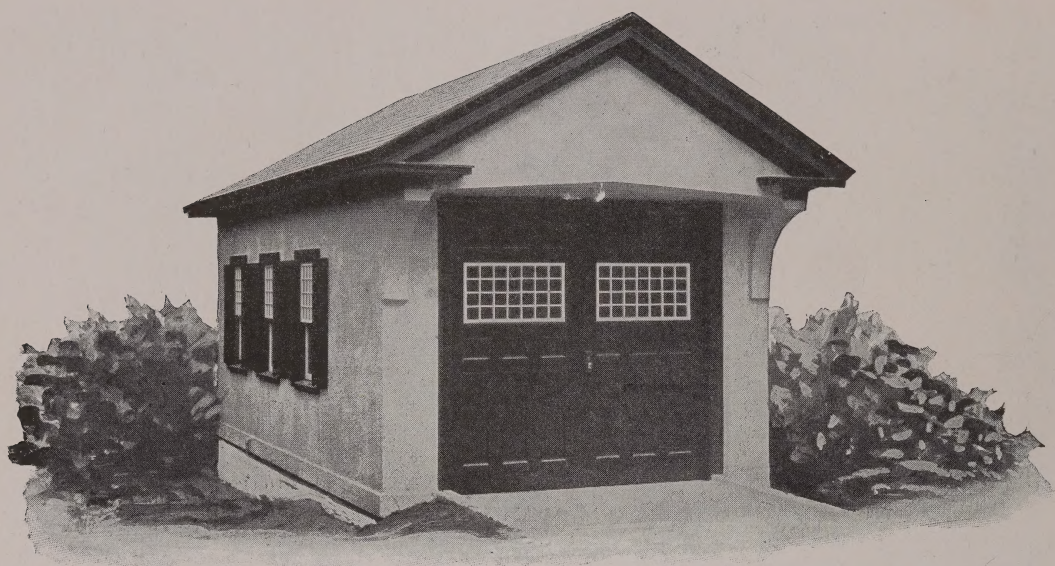
The building of a garage is very much like that of a house. Generally it is constructed at the time the house is built. Further details of interest may be found elsewhere in this book under the title of "Small Concrete Buildings." (Page 57.)



It is most important that the garage be absolutely fireproof. No inflammable building materials should be used. The fact that modern garages everywhere are built of concrete is a strong indication that architects and builders recognize this material as the proper one for garage construction.

The many advantages of concrete over other building materials for garages are obvious. It has demonstrated its fire-





AN INEXPENSIVE · ONE · CAR · GARAGE ·

BILL OF MATERIALS FOR CONCRETE WORK

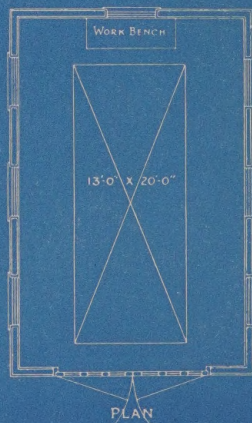
ALPHA Cement	33 barrels
Sand	11 cu. yds.
Stone	20 cu. yds.
$\frac{1}{4}$ " reinforcing rods	1200 lin. ft.
$\frac{1}{2}$ " reinforcing rods	50 lin. ft.



FRONT ELEVATION

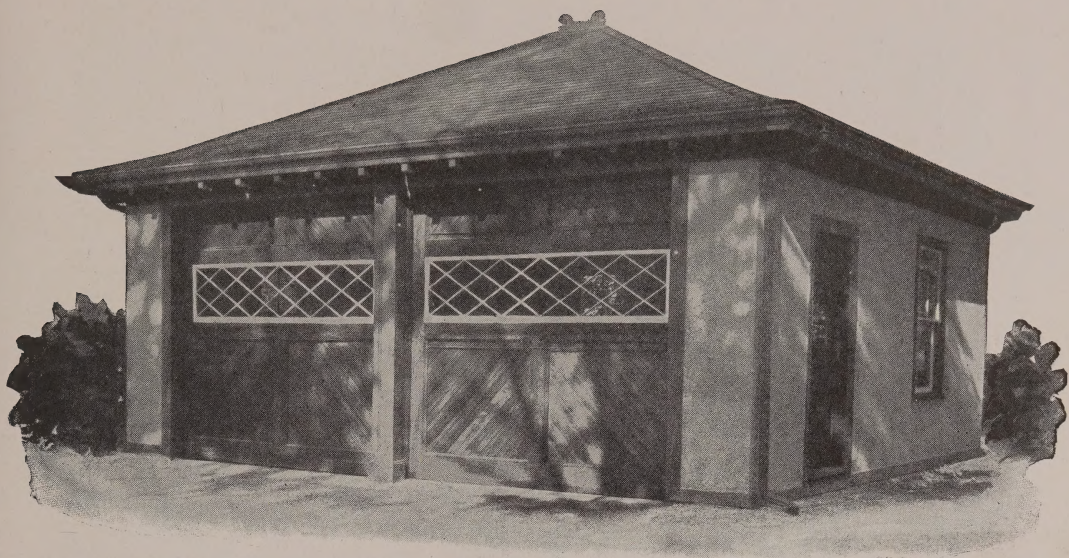


SIDE ELEVATION



PLAN

· SCALE · $\frac{1}{8}$ " = 1'-0"



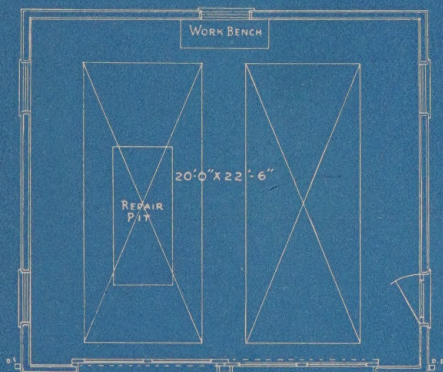
AN ATTRACTIVE TYPE of TWO-CAR GARAGE



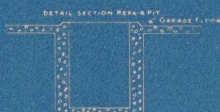
FRONT ELEVATION

BILL OF MATERIALS FOR CONCRETE WORK

ALPHA cement	38 barrels
Sand	13 cu. yds.
Stone	22 cu. yds.
$\frac{1}{4}$ " reinforcing rods	1200 lin. ft.
$\frac{1}{2}$ " reinforcing rods	90 lin. ft.

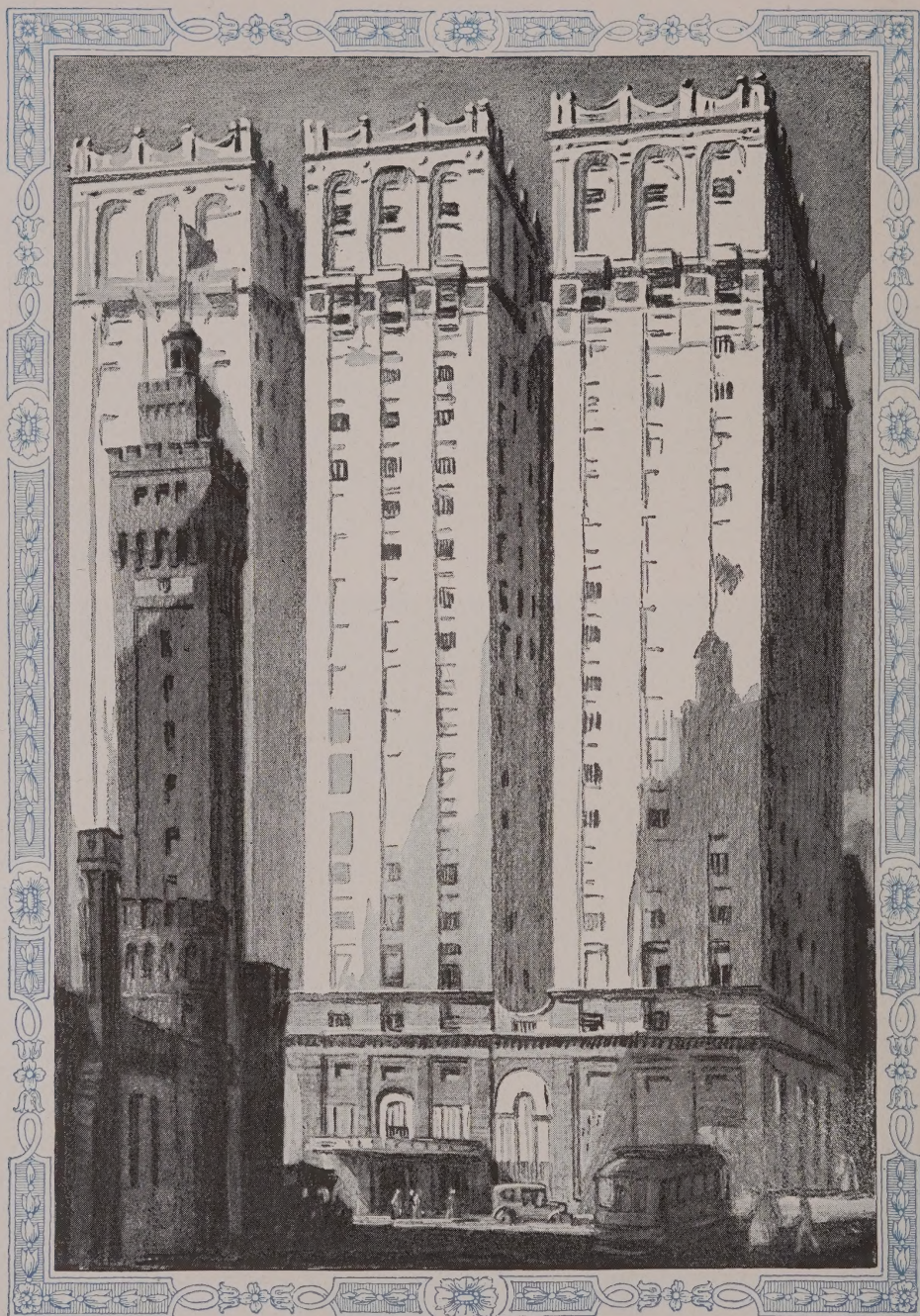


PLAN



SIDE ELEVATION

SCALE: $\frac{1}{8}$ " = 1'-0"



The Vanderbilt Hotel
(New York)

MODERN in every detail, this magnificent skyscraper hostelry dominates the hotel section of the metropolis. Such are its fireproof qualities that a raging fire among unpacked furnishings was confined to the corridor of one floor and extinguished before many of its guests knew that there had been a fire.

Besides being absolutely firesafe, the Vanderbilt is permanent—built to last for all time. The materials used in its construction had to pass severe tests, applied by the engineers responsible for the work. That 60,000 bags of ALPHA CEMENT were used speaks well for the quality of the cement that is tested hourly by the chemists in the making.



KEEPING fences in good condition is no easy task where the material in the post needs constant care and repair. Even the best wood posts will burn, rot, get out of line, break under heavy strains, or wash out in a flood.

The concrete fence post is everlasting. It keeps in alignment and can resist unusual strains without breaking. In some sections its first cost is no more than for a good wood post, but everywhere concrete posts are cheaper in upkeep than wood posts. No repairs, no painting; they grow stronger each year.

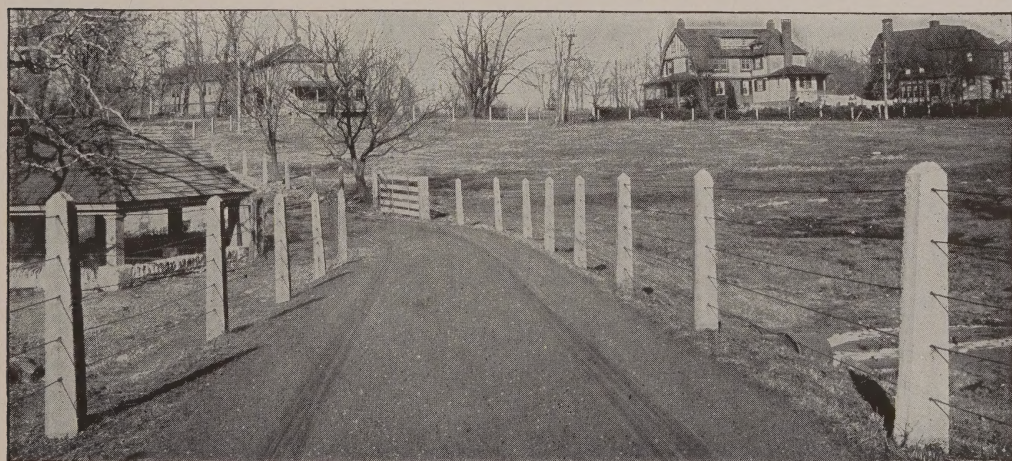
In comparing the advantages of concrete and wood fence posts, the U. S. Department of Agriculture, in Farmers' Bulletin No. 403, has this to say:

"After three years' service wooden

posts possess only from one-third to one-half of their original strength, whereas concrete grows stronger with age and needs no repairs, for neither weather nor fire injures it.

"Concrete posts are attractive in appearance because of their uniformity in size and color and, because of their durability, they effect a saving in giving greater life to the fencing material used, so that the permanent value of the property is increased."

The following table, compiled by the U. S. Department of Agriculture, shows the average cost and the average life of various kinds of fence posts. Note that concrete fence posts last nearly twenty years longer than the best wooden posts and cost only a few cents more.



Concrete fence posts on farm of Haverford College, Haverford, Pa. Made with ALPHA CEMENT

CONSTRUCTION · OF · AND ·

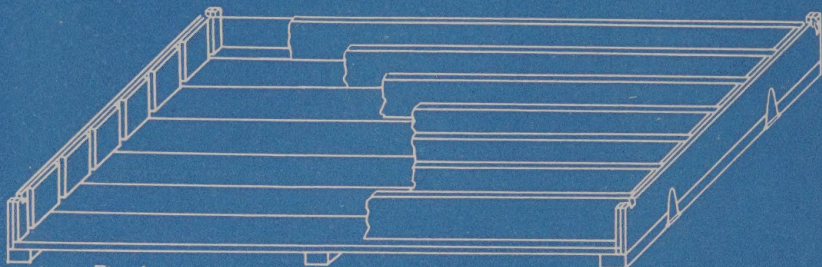


Fig. 1.

Gang mold for Concrete fence posts without taper

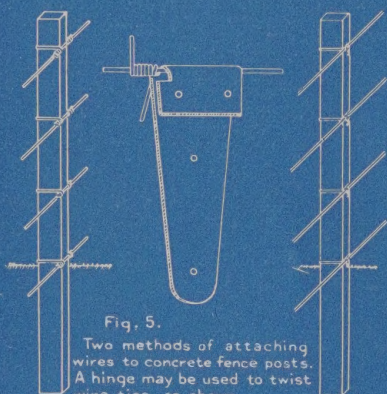


Fig. 5.

Two methods of attaching wires to concrete fence posts. A hinge may be used to twist wire ties, as shown.

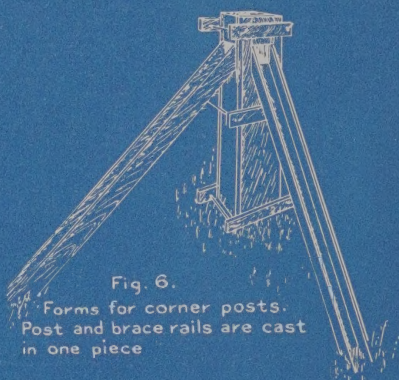


Fig. 6.

Forms for corner posts. Post and brace rails are cast in one piece

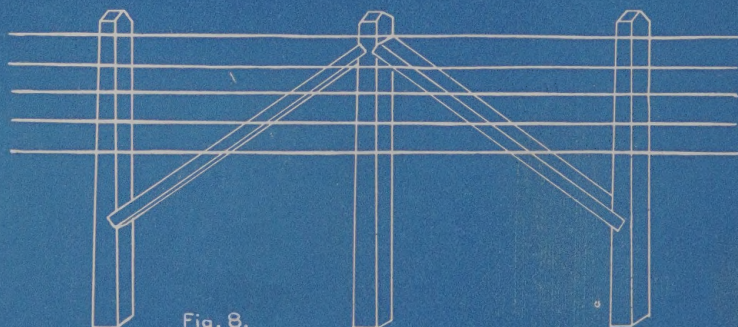


Fig. 8.

Method of bracing fence line every thirty posts. Principle is same as in Fig. 7.

CONCRETE · POSTS · INCLOSURE · WALLS.



Fig. 2.

Proper position for reinforcing rods in various types of concrete fence posts



Fig. 3.
Wire spacer used for holding reinforcing rods in place.

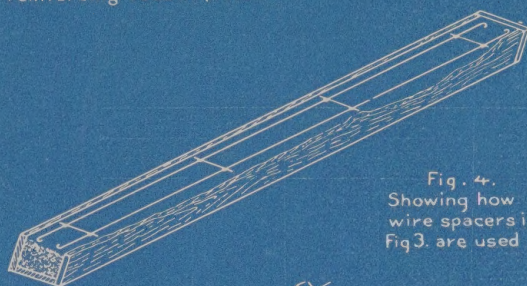


Fig. 4.
Showing how wire spacers in Fig. 3. are used

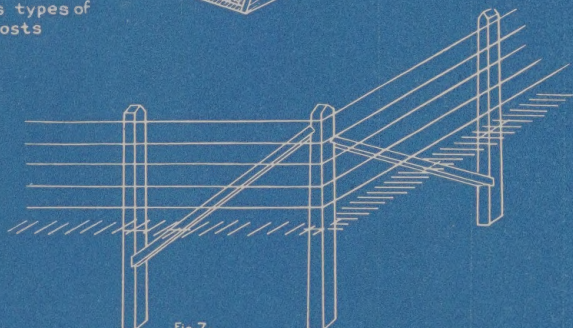


Fig. 7.

One method of bracing corner posts. Mortises are cast in corner and brace posts. Concrete brace rails are inserted in mortises as shown.

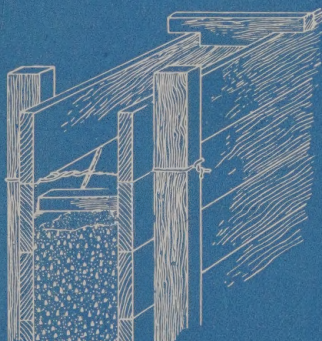


Fig 9.

A common method of spacing and tying forms for concrete walls

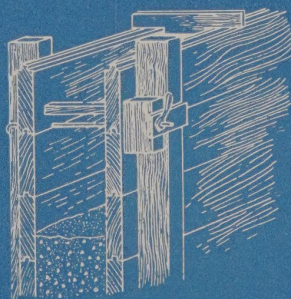
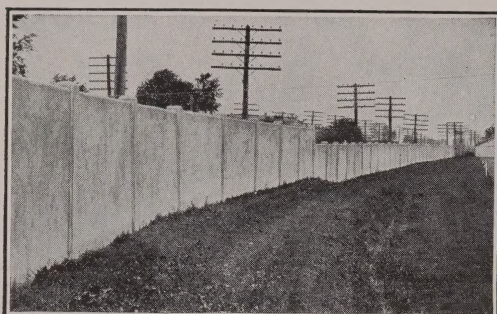


Fig. 10.

The rod and clamp method of holding wall forms in place

ALPHA CEMENT — HOW TO USE IT



Concrete wall around athletic field, Newark, Del.

Molds for Concrete Posts

The size of concrete posts must be governed by individual requirements, by the character of soil, and by probable strains they must stand. For ordinary fencing, no post should be smaller than 3 inches square at the top, 4½ inches square at the bottom and seven feet long.

In fences, three types of posts are generally used: line-posts, bracing-posts and corner-posts; ranging in the order mentioned from average to heavy weight.

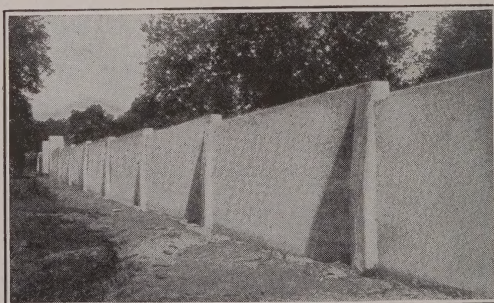
Concrete line posts vary. Besides triangular posts, rectangular posts can be had tapering on two sides, or on four sides, or without taper. Molds for this last named type are easiest and cheapest to make, because they can be constructed in 'gangs' or 'sets' with continuous bottoms and end pieces. Such molds can be made at home, or patent steel molds may be bought. If a number of neighbors club together it would make the cost of molds very reasonable and the construction of posts quick and easy.

Reinforcing Concrete Posts

Concrete is strong but quite inelastic. It is best therefore to combine the strength of concrete with the elasticity of steel by imbedding steel rods in the concrete.

Since strains on a post may come from any direction, it is necessary to distribute the reinforcing to all sides of the post as indicated on the preceding page. One big rod in the center will not do. The size of rods depends upon the size of the post. Ordinary $\frac{3}{16}$ -inch to $\frac{5}{16}$ -inch diameter rods

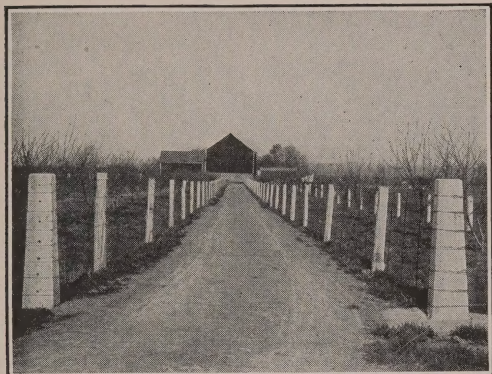
KIND OF POST	Average Life		Average Cost In All Areas	
	Number Estimated	Years	Number Estimated	Cents
Osage Orange	789	29.9	774	22
Locust.....	464	23.8	465	24
Red Cedar...	557	20.5	574	29
Mulberry...	88	17.4	82	19
Catalpa.....	48	15.5	45	17
Bur Oak.....	97	15.3	90	15
Chestnut....	94	14.8	91	15
White Cedar	1749	14.3	1709	18
Walnut.....	60	11.5	56	13
White Oak.	1242	11.4	1218	12
Pine.....	41	11.2	37	18
Tamarack....	67	10.5	64	09
Cherry.....	9	10.3	9	08
Hemlock....	10	9.1	9	12
Sassafras....	19	8.9	17	14
Elm.....	15	8.8	15	12
Ash.....	69	8.6	58	10
Red Oak...	22	7.0	24	07
Willow.....	41	6.2	33	07
Concrete...	42	48.0	121	30
Stone.....	11	36.3	15	35
Steel.....	131	29.9	219	30



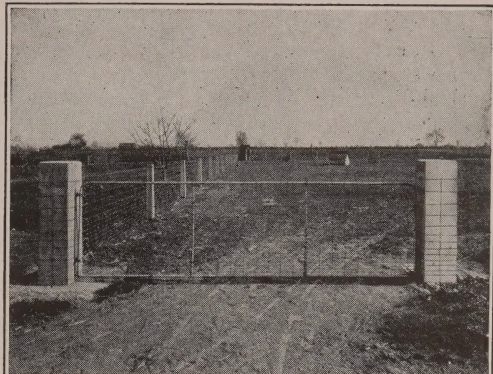
Concrete wall built by erecting posts and reinforcing rods first, and then filling in sections between posts. If posts are equally spaced, two sets of wall forms are sufficient—one set being used while the other remains in place to let concrete harden.

(Photos from American Thresherman and Farm Power)

ALPHA CEMENT — HOW TO USE IT



Concrete corner posts add years to the life of wood fence posts



Concrete posts prevent gates from sagging

will suffice. Wire of proper size may be used but rods are more economical. They must always run the full length of the post, extending as far down in the ground as the post goes. To hold reinforcing rods in place while concrete is being placed, wire spacers are used. These spacers are of No. 16 wire twisted as shown in Fig. 3 on page 47, and used as shown in Fig. 4. Three or four spacers are used to a rod. Note, too, that the ends of rods are turned back about an inch.

Molding Concrete Posts

Molds should be treated as suggested on page 47. Concrete for posts should be mixed only in quantities enough for immediate use, following directions on pages 11 and 17. No concrete that has stood for thirty minutes after mixing, should be used.

After the molds are filled to a depth of $\frac{3}{4}$ -inch to 1-inch, two reinforcement rods, properly placed, are laid in. The molds are then filled to within $\frac{3}{4}$ -inch to 1-inch of the top, when the remaining reinforcing is placed. They are then filled to the top.

As soon as the molds are filled, they should be tapped or moved up and down quickly from the corners. This will release air bubbles and make the concrete more compact.

The exposed corners of the post may be bevelled off with an edger and the open face given a smooth finish with a trowel immediately after the surface water has been absorbed and before the concrete has become too hard.

Curing Concrete Posts

After being placed concrete should be left in the mold two or three days to harden. When the end pieces and partitions of the mold are removed, the posts should be left on the bottom board in the shade for a week or ten days, and protected as suggested on page 18. After ten days posts may be moved outdoors and piled as wood posts are piled. They should be handled with great care, as a slight drop may break a fresh post. Jarring may cause cracks, invisible at first, but seriously weakening.

Concrete posts may be used when thirty days old, but not sooner. Concrete gains strength during the first year.

Attaching Wires. There are several ways of attaching wire to posts. Fig. 5 in the blueprint, as well as the illustration at the left, above, shows this.

Concrete Corner Posts. Corner posts stand heavier strains than line posts, and should therefore be braced properly. They are generally made from 6-in. x 6-in. to 12-in. x 12-in. square without taper. The exact size is determined by particular needs. Reinforcing rods range from $\frac{9}{16}$ -in. to 1-in.

On account of their weight and consequent inconvenience in handling, posts larger than 8 inches square are generally cast in place. A hole dug in the ground is filled to the ground-level with concrete. Forms are put in position and filled with concrete. If the ground is not firm, forms should be set below as well as above ground.

ALPHA CEMENT — HOW TO USE IT

In corner posts like that in Fig. 6 on the blueprint, the large base or underground part is built up of concrete made with field stones in assorted sizes. Unless corner posts are so massive that they will stand of their own weight, they must be braced. (See Figs. 5, 6 and 7 on the blueprint.) Braces as well as posts, must always be reinforced.

Posts may be made monolithic with braces, or posts may be notched or mortised about 8 inches from the top on the sides where the bracing is necessary. Brace rails are cast in molds. One end of the brace rail is inserted in the notch of the post, and the other end inserted in a similar notch near the bottom of a brace post. (See Fig. 7 on the blueprint.) A brace post is heavier than an ordinary line post.

In a fence it is well to brace about every thirtieth post. To do this it is necessary that the thirtieth post, and the post on each side of it, be a little heavier than the rest in order to support the brace rails.

Gate posts and hitching posts are made in the same manner as corner posts. Holes for bolt hinges are sometimes made by inserting a piece of gas pipe in the fresh concrete. Sometimes a hinge with a clamp strap that entirely encircles the post is used. Gate posts should be braced

unless they are made massive enough to withstand the strains. There is no limit to the many artistic effects possible to secure with concrete in the making of gate posts.

Concrete Inclosure Walls

Concrete walls are more attractive and more lasting than any other inclosure wall. They need no repairing or painting and are therefore economical.

The principles of construction are very much like those for house walls (see pages 20 and 23). An excavation deep enough to carry the foundation below the frost line is filled with a 6- or 8-inch layer of broken stone, cinders or brickbats, and then filled to the ground level with concrete.

Forms should be of one-inch material, well braced with 2 x 4 studs set closely enough together to prevent the bulging of form boards when the concrete is placed. While the concrete is being poured the forms are held securely in place by means of wire ties, bolts, wooden strips, etc. See Figs. 9 and 10 in the blueprint.

Reinforcing in concrete walls should be placed near the center of the wall. Usually reinforcing rods in such walls run horizontally, but both vertical and horizontal may be used, as shown on page 48.



Concrete posts used to support wood fence alongside Pennsylvania Railroad tracks

ALPHA CEMENT — HOW TO USE IT

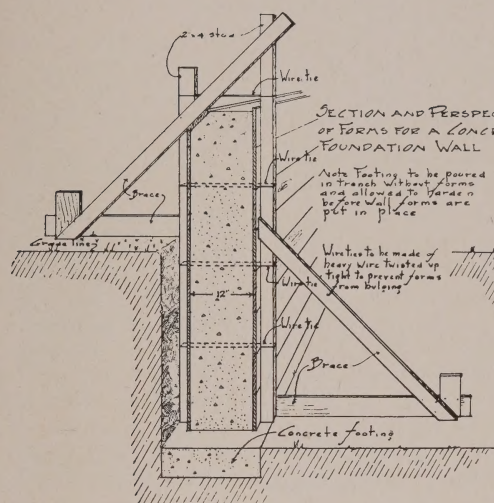


Fig. 1

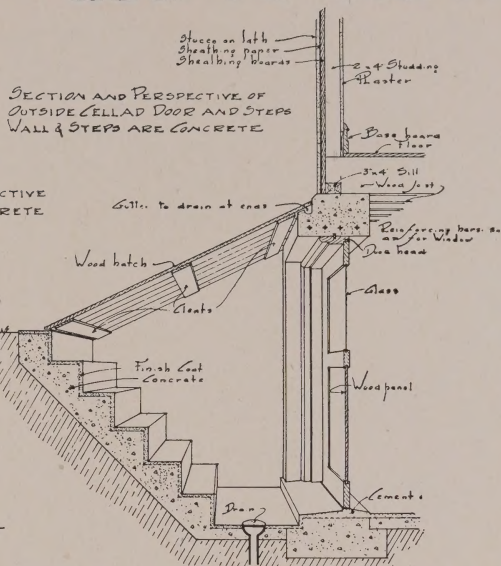


Fig. 2

Foundations, Walls and Steps

Fig. 1. illustrates in section and perspective forms for a concrete foundation wall. It will be seen that the footing has been placed in the trench without forms and forms for the wall set up on the footing after the concrete has become firm. In order to provide a good bond between footing and the wall proper, it is well to leave the surface of the footing quite rough, in fact better bond can be secured by partly embedding in the upper surface of the footing rough field stones so that when concrete for the wall is placed bond can be secured with these stones. The text in this book under the heading of "Forms and Reinforcement" gives a number of excellent ideas on foundations.

Foundations Under Old Buildings. A complete concrete foundation can readily be built under an old building. All that is necessary is to remove from the old wall a few of the stones or bricks as the case may be, at various points around the foundation and insert short pieces of heavy timber to wedge up the building. The building should be carefully raised in this manner entirely clear of the old foundation.

Then all of the old foundation should be removed and a trench dug and forms set in place in the usual manner for concreting. In the case of small buildings it is usually easy to raise them high enough to allow working room, in which case the forms can be filled right up to the top with concrete. If the building is large and too heavy to be raised readily so as to provide necessary working headroom, the foundations may be made 3 inches wider than the sill. When the forms have been carried to the desired height the concrete may be inserted through this extra space of 3 inches. To make placing of the first layers of concrete easy the top board of the forms may be left off until ready to place the last layer of concrete. The building should not be lowered upon the foundation until the concrete has had at least two weeks to harden. After this time the timbers used for the purpose of wedging up the building may be removed and the openings which they occupied be filled with concrete.

Cellar Steps are shown with construction detail in Fig. 2. While side retaining walls may be built before or after cellar steps are constructed, it will usually be found more convenient to place the forms for the steps after the side walls have been built.

ALPHA CEMENT — HOW TO USE IT

Before laying the concrete for the steps the slope on which they are to rest must be well compacted so that there will be no settlement and consequent cracking of the concrete. If there is any doubt as to the sustaining power of the soil it would be well to lay a 2-inch layer of concrete first on this slope and then to embed in it $\frac{1}{4}$ -inch rods placed 12 inches center to center, after which concreting of the steps

plank should be kept at a height above the bottom of the wall sufficient to form the first step.

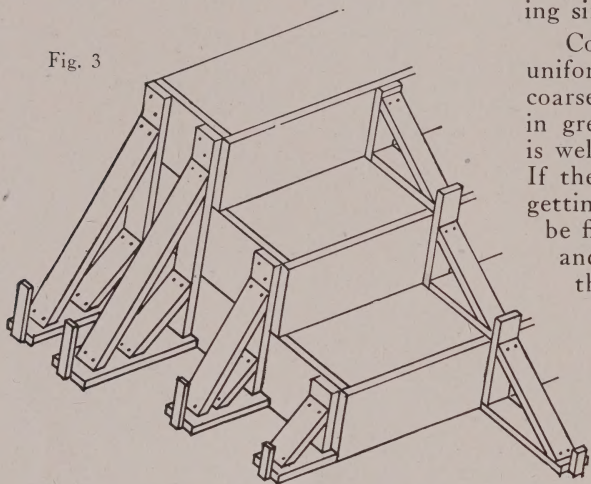
After the concrete for the wall is placed, remove the section of the form where the steps are to come, and dig out the earth to a depth sufficient to hold them. The remaining steps are built in the manner described on page 33.

Fig. 3 gives suggestions for constructing simple forms for outside steps.

Concrete steps can readily be built of a uniform concrete throughout provided the coarse aggregate does not exceed $\frac{3}{4}$ inch in greatest dimension, and the concrete is well spaded when placed in the forms. If there is any difficulty encountered in getting a good surface finish, forms may be filled to within about $\frac{1}{2}$ inch of full and a 1:2 cement mortar in which the sand is coarse and hard be used to fill the remainder of the forms.

This finishing coat should be placed immediately after placing the other concrete so as to secure a good bond between base and wearing surface. If any irregularities appear in the face of the risers of the steps after forms are removed, these can readily be pointed up with a 1:2 cement mortar and be finally given a coat of cement grout paint if a smoother finish is desired, this being gone over with a trowel just as soon as the grout has commenced to harden.

Fig. 3



Construction of forms for concrete steps showing proper method of bracing

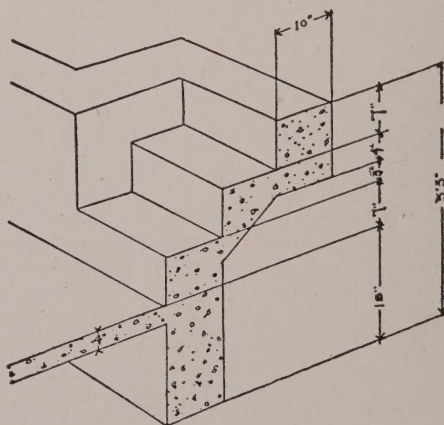
may be continued. This reinforcing will serve to prevent cracking at the relatively thin section of the concrete where the tread and the rise meet.

Retaining Wall and Steps

Terraces if too steep, will not stay sodded, and if too flat take up room which would otherwise be a part of the lawn. The neatest way is to place a retaining wall along the terrace edge.

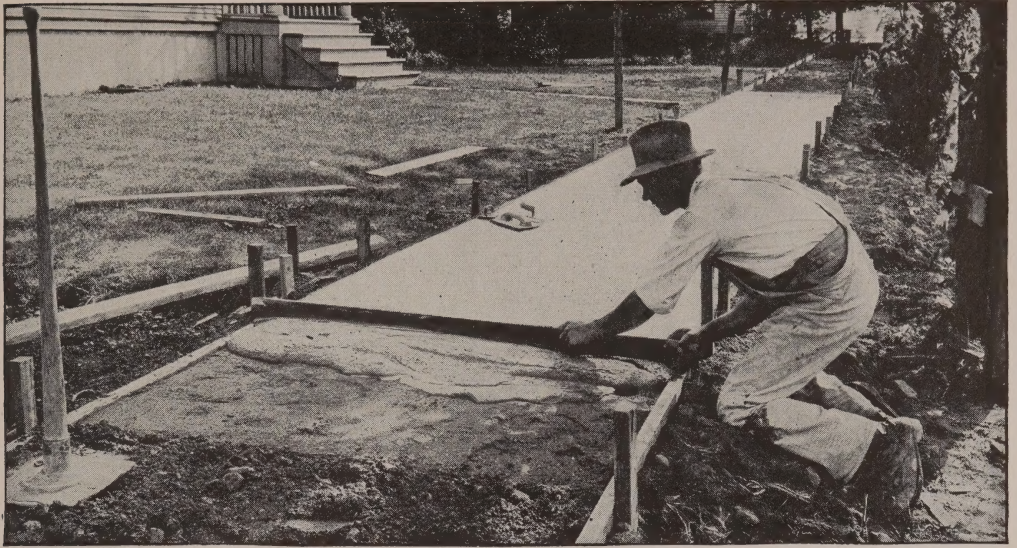
If the wall is over 1 foot high steps are necessary. A most convenient arrangement is to have the bottom step come flush with the face of the wall, making it impossible to fall over one or two projecting steps in the dark.

In building, insert a stop plank between the front and back forms to prevent the concrete from going to the full height of the wall. The bottom of this



Cross-section of retaining walls and steps

ALPHA CEMENT — HOW TO USE IT



Leveling surface of sidewalk by use of straight-edge

Walks and Floors

Concrete floors are simply strips of concrete walks laid side by side. Their construction is similar. Where walks and floors are to be laid out of doors, no individual slab should be greater than 6 feet in any one dimension (36 square feet).

Drainage. The first essential to success in outdoor walk and floor construction is that the soil where the walk or floor is to rest shall be well drained so as to prevent water from being retained beneath, thus causing upheaval in case of freezing. The area upon which concrete is to be laid should be cleaned of all vegetation and similar refuse, and if the soil is not firm so as to provide a good foundation it should be thoroughly compacted by rolling or tamping so that everywhere there will be the same uniform bearing power. All soft or spongy spots should be dug out and filled with clean gravel containing little sand or clean, hard cinders, and these should be well compacted. If the soil is one that naturally retains water, it may be necessary to construct a subbase of clean, well compacted cinders or gravel, but when such a subbase is used it must be connected with drain outlets so that

water will not be retained in the subbase. Where good drainage can be secured without providing a subbase, such a method of preparing the foundation is preferable. A walk should be higher in the center, or at one edge, to insure the water running off. This slope should be $\frac{1}{4}$ of an inch to the foot.

Upheaval by Tree Roots. Upheaval by tree roots can be easily avoided by cutting out all roots which run under the pavement at a less depth than 18 inches below the surface of the ground.

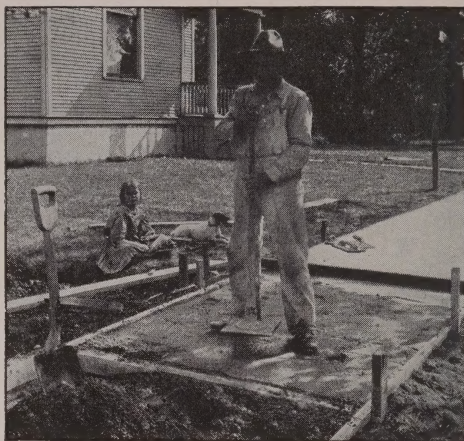
General Construction Methods. Floors or walks may be either of one- or two-course construction. For feeding floors, barnyard pavements, driveways and ordinary walks around the farm, one-course construction is to be preferred. For such work a 1:2:3 concrete should be used, and generally speaking no outdoor walk or floor should be less than 5 inches thick. Depending upon the thickness of the pavement, 2 by 4's or 2 by 6's will serve for forms. These should be securely staked so as to prevent bulging out of line when concrete is being placed. For one-course construction a nearly quaky concrete is preferable, and to facilitate finishing, coarse aggregate should not be larger than 1 inch in greatest dimension.

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Importance of Good Bond. One great advantage of one-course construction for outdoor floors, pavements and walks is that there is no possibility of separation between top and base, as the whole thickness of concrete is placed at one time, while in two-course work unless the base course is mixed to correct consistency and the top, also of correct consistency, placed before the concrete in the base has commenced to harden, there is likely to be a separation between top and base. This does not mean that first-class two-course construction is not or cannot be secured, for most sidewalk work is of two-course construction.

Arrangement of Forms. In setting up forms for walk, floor and pavement construction, stakes should be driven so that alternate slabs can be concreted first. After these have hardened sufficiently so that form cross-pieces can be removed, intermediate slabs are concreted. In this way a perfect joint is secured through the entire thickness of the slab so that each slab is a unit. If this is not done and settlement or heaving should occur, the walk or pavement is likely to crack. With every slab independent of the other any settlement that may occur is not likely to injure slabs and they can even be reset if necessary to resurface the walk just in the same manner as would be done with stone sidewalk slabs.

Surface Treatment and Protection. In walks, floors or pavements that are to be subjected to any considerable wear, particular attention must be given to the aggregates used in the concrete and to the method of finishing the surface after concrete has been placed. Too much troweling of a floor or pavement or troweling it too soon after depositing the con-

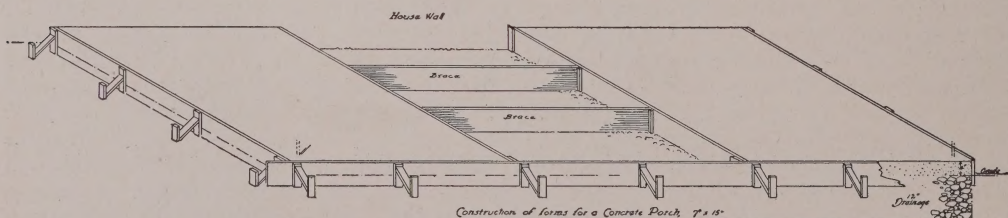


Tamping the base in sidewalk construction

crete, not only makes the surface slippery but brings an excess of fine material to the surface which reduces the wearing quality of the pavement. Unless an exceptionally smooth finish is desired it is always preferable to finish outdoor walks and floors with a wood float. This will give a slightly gritty texture that will result in a non-slippery surface upon which animals and persons can obtain good foothold.

To protect concrete walks, floors and pavements newly placed, they should be covered with moist earth, or similar material, as soon as possible to do so without marring the surface, so as to retain the water which is in the concrete and prevent too rapid drying out. The protective covering should be sprinkled several times daily to keep it moist and thus assist the hardening of the concrete.

Generally speaking, indoor floors should be laid in slabs not greater than 10 feet in any one dimension, unless the concrete is reinforced. In using expanded metal or woven wire fabric in floor slabs, particular care should be taken to lap the



Setting forms for porch floors or walks, so that alternate slabs are constructed first

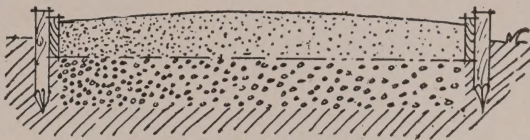
ALPHA CEMENT — HOW TO USE IT

fabric at least the width of one mesh and wire the edges and ends together securely.

Causes of "Dusting". All that is necessary to make indoor floors hard is to employ only the best materials and workmanship, and to lay them properly.

Causes of dusting have been definitely fixed in the use of too fine or dirty sand, soft sand, too lean a mixture, coarse aggregate coated with dust or clay, unclean material of any sort, overtroweling when finishing, insufficient mixing, too much time allowed to elapse between placing and finishing, using mixtures too dry or too wet. The use of driers, that is, dry cement with or without sand to dry out the surface rapidly so that it might be quickly troweled to the desired finish, will likely rob the concrete of the water necessary to complete the hydration of the cement.

In two-course work when a thin top or wearing surface is placed on a base which has already hardened, there is likely to be dusting because there is no possibility of the base absorbing excess water from the top course, and any excess must get away through evaporation from the top surface. Dusting may also be due to improper bond between cement and fine aggregate, which permits the fine particles of grit to become loosened from the cement binder.

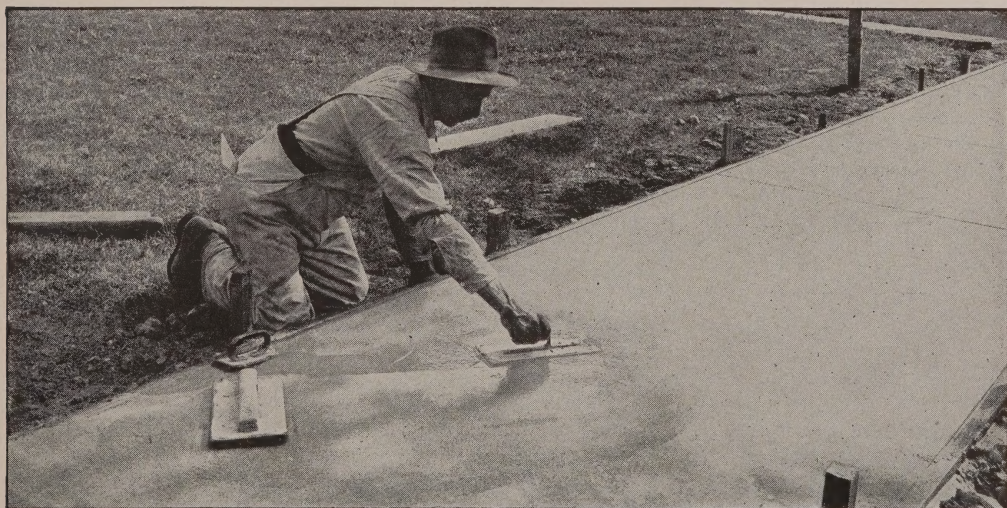


Cross-section of properly constructed sidewalk. Note how filling material is placed under concrete

Selection of Aggregates. Particular attention must be given when preparing concrete mixtures for floors to select clean, hard, durable, well-graded aggregates and to proportion them so that voids will be eliminated as nearly as possible.

Concrete Hardeners. Several preparations are advertised as hardeners to be used when finishing concrete floors. So-called methods of finishing are also exploited. Whatever success comes from the use of such preparations or methods, could very likely be achieved with a careful observance of good concreting principles, and without additional preparation or methods. In fact, success depends mostly upon good concreting practice, not upon additional materials or methods.

Final Hints. If the top coat of a two-course floor is deposited too wet, several trowelings may be necessary to secure the final surface finish desired, thus breaking up the crystallization of the cement in setting and destroying the ultimate wearing



Finishing surface after concrete has stiffened but before it has become hard

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quality of the surface. In two-course work the top-course mixture should be so stiff that it will have to be scraped from buckets or wheelbarrows when dumping in place. It should then be quickly struck off and smoothed to the desired finish as quickly as possible, and a protective covering applied as soon thereafter as can be done without marring the surface. If the concrete is kept thoroughly moist for a week or ten days after placing, the dusting that may occur after the floor is put into use will be only temporary, provided the aggregates have been selected and proportioned for durability.

Curbs and Driveways

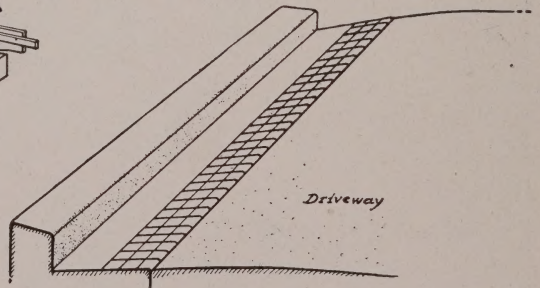
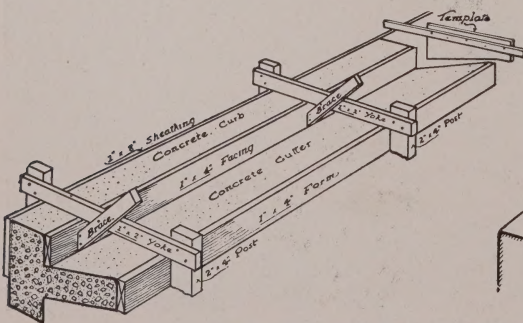
To build a fine concrete walk or driveway without protecting the edges with curbing, would mean the formation of irregular and disfiguring gutters established by nature, if not the undermining of the structure. The additional expense, of adding curbing while the work is under way would represent a small outlay compared with its value. It is a simple matter to construct substantial concrete curbing. When properly done it will not get out of alignment as is the case with stone curbing. It may be brought to an exact line and finish, thus corresponding in texture and appearance to the thing it protects. Concrete is used for this purpose in all large cities and towns, and in response to the great demand for curbing of this character, machinery has been invented to facilitate construction. The same good results however, may be secured where

the work is done by hand. A standard method of constructing ordinary curbing, such as would be suitable for the farm or a suburban property, might be described as follows:

At the edge of the pavement, and measuring from its finished surface, dig a trench 12 inches deep and at least 6 inches wide. Place over this the forms, the bottom of the forms being on a level with the finished surface of the road. Make the forms about 6 inches high. The forms should be placed both back and front of the proposed curb, the front form having a batter or incline of $\frac{1}{2}$ inch. Concrete should then be deposited in the ditch and within the forms, and the upper surface smoothed off with a steel float and all small surface interstices filled in with a 1:1 mortar in case this is necessary. The upper edge should be rounded with a 1-inch rounding tool so as to give a neater appearance. The moment the concrete is sufficiently hard not to pit under sprinkling, this should begin and the concrete should be kept wet for at least two days. The more frequent and prolonged the sprinkling of the newly-finished work, the better the results.

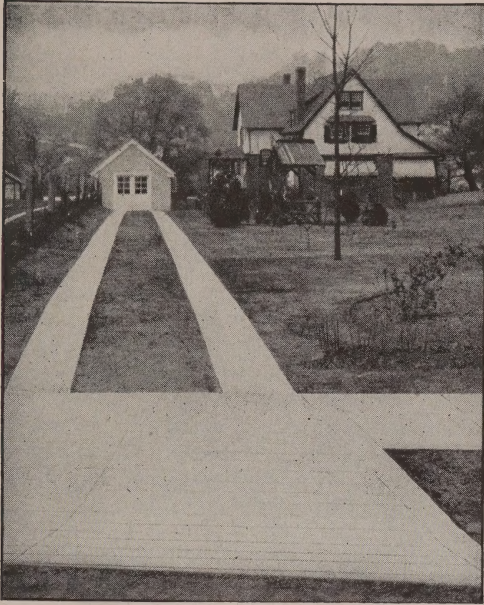
Concrete Driveways

The concrete driveway is reasonable in first cost, and if well built, will last indefinitely. Even on highways subject to constant traffic of all descriptions, concrete has proved to be more satisfactory than any other material of like cost. For example, a concrete road put down in Bellefontaine, Ohio, more than twenty years ago has cost less than \$25 per mile per year for maintenance during that long period of time. On a private driveway of



Sectional view of concrete curb before and after removing forms

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A method of saving concrete in an automobile runway

concrete up-keep cost should be practically negligible. It is in recognition of its durable and economical properties that many owners of large country estates are substituting concrete for macadam and other types of roads.

In building a driveway to a house to provide for private automobile or service traffic which is seldom excessive, lay the concrete 5 inches at the sides and 6 inches at the center. This thickness will be amply sufficient for such infrequent traffic. The proportions should be 1:2:4. The concrete should be mixed to a mushy consistency and when in place between side forms, which should be rigidly staked at each side of the road, proper shape should be given to the road by means of a template, a long plank reaching from side form to side form, and cut to the desired crown. After bringing the road to proper contour by the use of the template the surface should be evened up by lightly troweling with a wooden float. When the concrete is sufficiently hard not to pit, the surface should be sprinkled with water, and when the concrete will stand the weight of a man, it should be covered with about 2 inches of earth, which should be kept wet for at least ten days. No

traffic should be allowed upon the road for two weeks. Cut at every 25 or 30 feet what are known as expansion joints. These expansion joints should be filled with asphaltic felt or tar paper. Where the driveway receives very heavy loads, such as hay wagons and large trucks, make the concrete 6 inches at the sides and 8 inches at the center, and mixed in the proportions of 1:2:3. Otherwise the method of construction is the same as already described, with the exception that the edges of the joints should be protected by special steel plates.

Concrete Tracks for Automobiles

In some cases property owners possessed of small lots have adopted a rather ingenious method of making concrete roads for automobiles by digging trenches and establishing therein narrow concrete tracks as shown in the accompanying illustration. This type of construction is not practicable where vehicles pass each other, and is intended solely for a private driveway with turf between the tracks and on both sides so as not to make it a conspicuous thoroughfare.

Small Concrete Buildings

Strength, permanence and freedom from repairs and constant expense are just as much a part of small concrete houses as large ones. Small concrete buildings include chicken houses, ice-houses, hog houses, machine sheds, smoke houses, garages, dairy buildings and other similar structures.

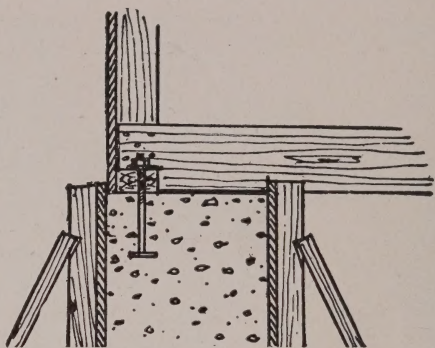
In a way, all well constructed buildings are built by following certain so-called "specifications," and except as it is necessary to vary certain details of a specification to provide for different foundations so that the weight of different sized buildings will be properly carried by the soil, one broad, general specification can be made to include most, if not all, of the requirements of construction. As regards concrete work, such a specification is equally as applicable to the small milkhouse as to the large concrete barn.

ALPHA CEMENT — HOW TO USE IT

Foundations for Small Buildings. As soils have different bearing capacity, the first thing necessary is to excavate foundation trenches to such a depth that firm soil will be reached to provide the necessary load-carrying capacity, or in the absence of deep excavations for foundation trenches, to construct a footing so that the load to be carried will be distributed over a suitable area, thus preventing settlement of the structure. It is also advisable, regardless of whether or not a footing is necessary, to begin the foundation sufficiently below ground level to prevent possible disturbance from frost penetration and the heaving that may result. This varies considerably, according to climate. All roots, sod and any other refuse material must be removed and all soft or spongy spots be excavated, and the holes filled with clean, well tamped material. Clean gravel or cinders are suitable for the purpose.

Sometimes it is necessary after footings have been completed and have thoroughly hardened and walls have been finished to ground level, to excavate inside the enclosure and provide a suitable subbase for a concrete floor where such is to be part of the structure. Often the floor is constructed immediately after completing the foundation walls to ground level; otherwise, it is built after walls have been finished and the structure practically enclosed. In any event, on account of possibility of settlement, which undoubtedly would be unequal if it took place, a joint should be provided all around the inside of the foundation wall so that the foundation and floor are separate.

Thickness of Walls. For the average run of small buildings walls need be no more than 6 inches thick. The foundation for a structure of such type should start on a concrete footing 12 inches wide and 6 inches thick, 3 feet below ground level, in some cases deeper according to climate. On top of this there may be laid a 10-inch wall to ground level. As a matter of fact, a wall of lesser thickness would answer, but it is extremely difficult to excavate a narrower trench and place concrete in it without knocking



Method of inserting bolts in last few inches of concrete foundation so that sills may be secured tightly

down earth, so there is true economy of time and labor in building the thicker wall to ground level and continuing with a 6-inch wall from there on.

Proportions will be found in the Tables of Recommended Mixtures on pages 11 and 12.

When laying foundations upon which wooden structures are to be erected, it is always advisable to embed anchor bolts in the concrete so that the wood sill may be firmly anchored to the concrete. This in turn serves to anchor the whole building against possible destruction from heavy winds if the timbers are well framed into or fastened to the sills by stud anchors. Where sills are not used, such stud anchors are themselves attached to the concrete foundation by bolts previously embedded in the concrete at the time the last few inches of the foundation is constructed. See illustration on this page. These bolts are held in the position desired while doing final filling of forms, by suspending them from hangers resting across from inside to outside forms.

Roofs

Concrete roofs, like other concrete structures, reduce fire risk by eliminating the hazard of fire. Reinforced monolithic and a plastered concrete roof formed on a base or ground of metal fabric are used both for pitched and flat roofs. Usually the concrete roof is designed after the slab type with but little pitch.

ALPHA CEMENT — HOW TO USE IT

A slab 3 inches thick is about the most convenient to place. Such slabs properly reinforced, are suited to a span not over 8 by 8 feet. If the span is greater than that, the thickness of slabs should be increased $\frac{1}{2}$ inch for each additional 2 feet. The span represents the distance between the center line of walls.

The reinforcing for roofs of this type should be $\frac{3}{8}$ -inch round rods spaced 11 inches apart, center to center, where the roof is 8 x 8 feet, and $2\frac{1}{4}$ inches closer together for each additional 2 feet of span.

Forms for roofs should be so designed and braced when in place that they will not sag under the load of concrete they must sustain while the concrete is hardening. Without such precautions, progressive cracking while hardening will deprive the finished roof of strength and watertightness.

Forms should be left in place at least two weeks in favorable weather, and a month or more in cold weather, in order to prevent possibility of collapse when removed.

Pebbles used should not exceed in size 1 inch. In some cases, especially in the thinner slabs where the reinforcing lies rather close to the bottom plane of the slab, a $\frac{3}{4}$ -inch maximum size for pebbles would be better, since this will allow thorough placing of concrete under and around the reinforcing rods.

Concrete Poultry Houses

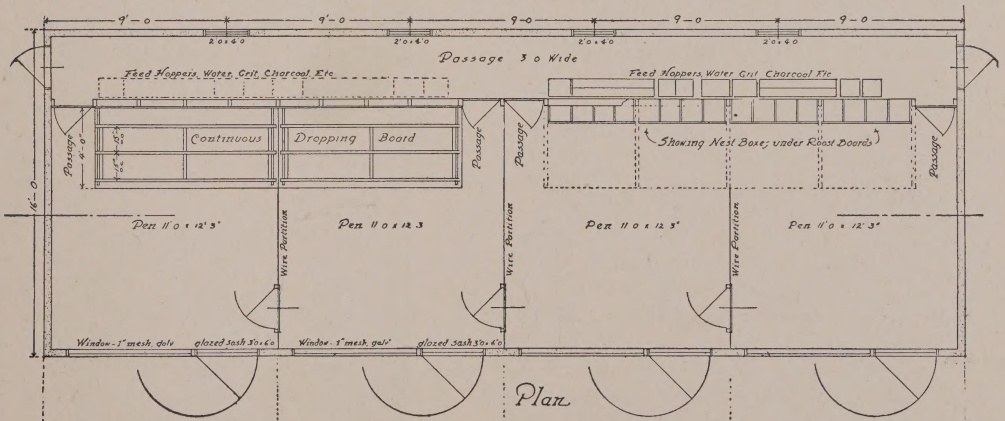
Hens can be made to produce large quantities of eggs and maintain such a production if they are provided with suitable quarters and are otherwise well cared for. Sanitation is a large part of success in poultry raising. Good concrete and good construction in a poultry house will improve sanitation by checking vermin and other poultry pests.

Foundation requirements are included in the chapter on "Small Concrete Buildings." (Page 57.)

This design, which is for a concrete poultry house 16 x 45 feet, may be halved if desired, without varying any of the construction requirements.

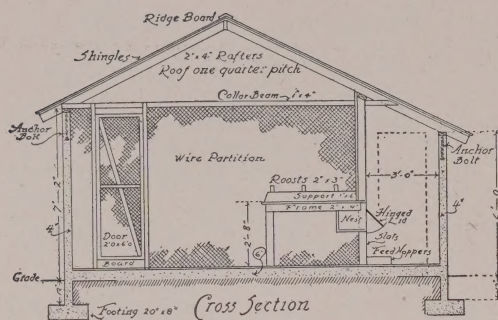
This poultry house plans ventilation from open windows covered with 1-inch poultry mesh and protected against extreme cold weather by muslin drop curtains. Dampness on walls of poultry houses can be avoided in the same way as in dairy barns. See page 65.

Concrete poultry houses are rat- and mouse-proof. Where the poultry house floor must necessarily be located on soil which is not favored with the best of drainage, then it is well to prepare a sub-base on which to lay the floor. This should be preferably 8 inches of well-tamped, clean gravel, or cinders free from ashes, and this subbase should be connected at several points to tile drains that



Floor plan of well arranged concrete poultry house

ALPHA CEMENT — HOW TO USE IT



Section view of poultry house

will prevent water from remaining beneath the floor. The floor should be of one-course construction, using a 1:2:3 concrete. On this floor there can be thrown any kind of clean litter for the animals to scratch in.

Poultry house walls should be of a 1:2½:4 mixture, in which the coarse aggregate consists of material well graded from ¼ up to 1 inch maximum size, on account of the thin wall section. See the chapter on "Forms and Reinforcement." The poultry house design here shown calls for only a 4-inch wall. Carefully constructed, this will sustain the weight well. Nevertheless, in general practice it would be better to provide for a 6-inch wall.

Concrete Icehouses

To the average farmer, an icehouse is convenient and profitable. To the dairy farmer it is necessary as well. The icehouse that holds and preserves ice sufficient to carry from one ice harvest to the next soon repays its cost in the savings made on ice. Idle days during the winter, put to harvesting and storing ice, bring the cost of ice very low.

Strange as it may seem, there is a fire-risk involved in the storage of ice.

Sawdust or hay or straw is used for packing and probably the variable content of moisture in these materials causes decomposition and consequent heating in a way similar to the heating in the decomposition of manure, and this frequently results in fire.

Wood is a poor material from the economic standpoint to use in icehouse construction. It is not fire-safe and soon rots out owing to the alternate wet and

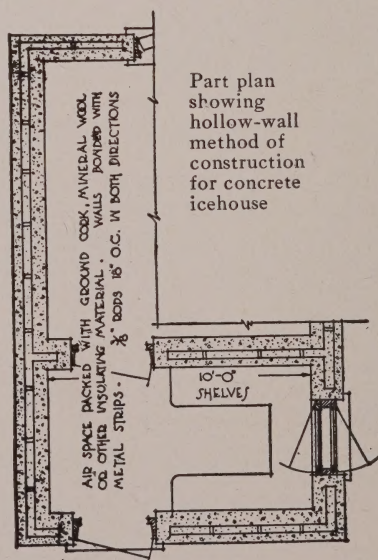
dry conditions to which exposed when the house is filled with ice, and from neglect when empty. No other material is so well adapted to icehouse construction as concrete.

The accompanying drawing illustrates how the same structure may be built by either of two methods—first, with a single monolithic wall; second, with double monolithic walls, thus providing an air space which accomplishes the best kind of insulation and hence reduces to a minimum the melting of ice from outside temperature influences.

A number of modifications of the plan will suggest themselves to fit possible individual requirements. For instance, it is quite a simple matter to extend a concrete refrigerator compartment into the ice storage room so that this compartment will always be surrounded with ice and hence serve as an actual cold room for eggs, dressed poultry, milk and cream.

The foundation and walls follow the specifications in the chapter on "Foundations, Walls, etc." and reinforcement suggestions will be found on page 23.

The floor of concrete slopes in all directions toward a central drain. This floor is made independent of the side walls and should be so laid that there will be a ½-inch joint all around which can be



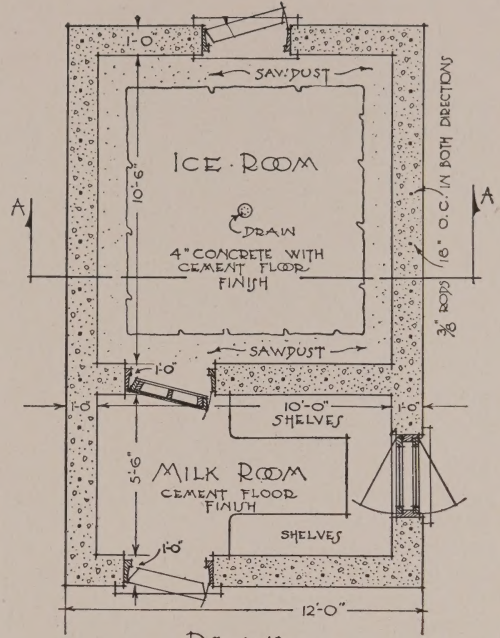
ALPHA CEMENT — HOW TO USE IT

sealed against leakage and entrance of air, by pouring into it hot tar or asphalt. The drain is "trapped" so that the water from ice melting will seal it against the possible entrance of air, thus preventing rapid melting of ice.

The smallest practical dimensions for the farm icehouse should be considered as 10 x 10 x 10 feet, giving contents of 1000 cubic feet. Since a cubic foot of ice weighs about 57 pounds, such a house would hold about 20 tons allowing for the usual waste of space in packing ice.

An icehouse should be located in a place convenient to the dairy barn, and on dry, well-drained ground. Building below the ground makes drainage difficult and removal of ice to the ground level equally difficult. It is generally more costly too, for an underground icehouse requires the same material and expense in building as one above ground, in addition to the cost of greater excavation. The soil is a good conductor of heat. During a large part of the year, ice will melt less in a surface storage room exposed to actual contact with air than in underground storage.

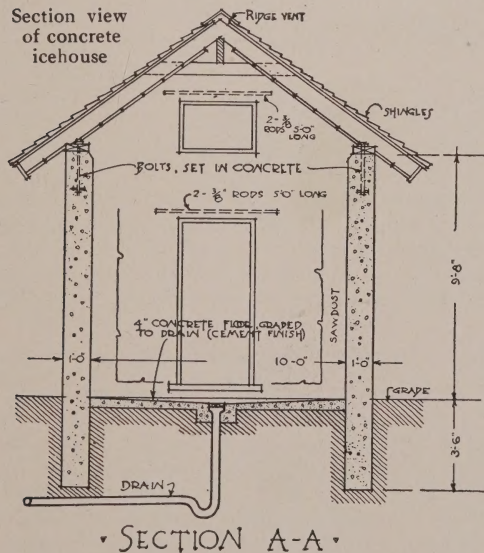
One of the best forms in which to use concrete for icehouse construction is hollow block. These should be of a type that will permit a wall being built with a prac-



Concrete icehouse

tically continuous air space throughout for the insulation thus afforded. The floor should be in a measure insulated from contact with the soil, by being laid on a wall-compacted 8- or 10-inch layer of clean pebbles or cinders free from ashes. If block is used in the construction, of course the type must be such as to permit suitable reinforcing to take care of the outward thrust resulting from ice pressure.

Although the accompanying plans show a wood frame and shingle roof, a concrete roof is by all means preferable. This also must be built so as to provide insulation which is accomplished by constructing, independent of each other, two sets of slabs suitably reinforced and separated from each other by a layer of clean, coarse cinders. There is true economy in the concrete roof since it is permanent, and in connection with the remainder of the construction, accomplishes complete fireproofness.



ALPHA CEMENT — HOW TO USE IT

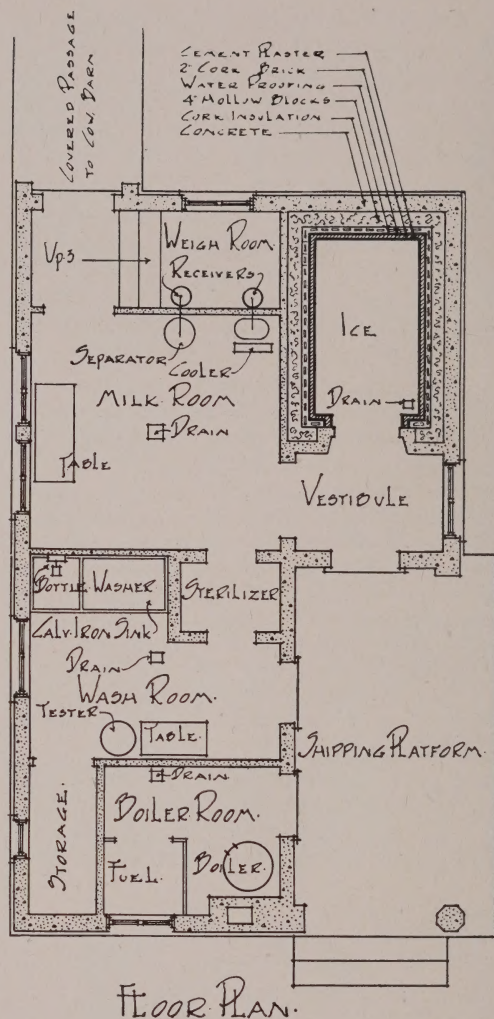
Concrete Milkhouses

Many city health authorities having the power to regulate the conditions under which the city milk supply is produced, require that concrete construction be used throughout dairy buildings on the farms furnishing milk, so as to make certain that sanitation can be maintained.

Accompanying designs show a very convenient layout for the dairy-farm milkhouse. Even the shipping platform is of concrete, so that everything about the structure is permanent. Fireproofness also is secured, which is quite necessary since the boiler room is a part of the building. The method of securing insulation for the ice compartment is shown in detail. Otherwise its construction is not unlike that described elsewhere for a small ice-house.

In this design the shipping platform is specified as 4-inch reinforced concrete. It would perhaps be better if this were made 6 inches thick as it would then be easier to place reinforcing and make certain that it was everywhere surrounded by and perfectly bonded with the concrete.

Although a good interior wall finish can be obtained by mixing the concrete to correct consistency and carefully spading when placing in the forms, it is always desirable to have an exceptionally smooth wall in a milk room so that the surface can be kept thoroughly clean, and it would be well after removing forms to rub down the concrete to the desired smoothness by using a carborundum stone as described elsewhere under "Surface Finishes," and when the concrete has become thoroughly dry to give the wall several coats of a white enamel paint of a kind

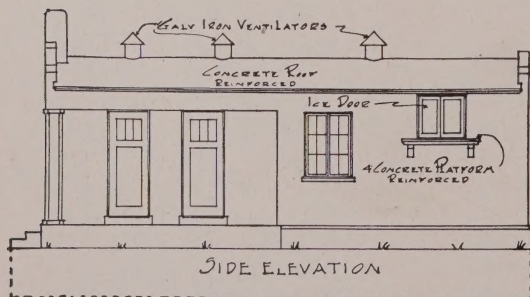


Concrete milkhouse

prepared especially for use on concrete surfaces. This will seal any pores on the surface and will be an incentive to greater cleanliness, since any dirt that may lodge on the white surface can readily be seen.

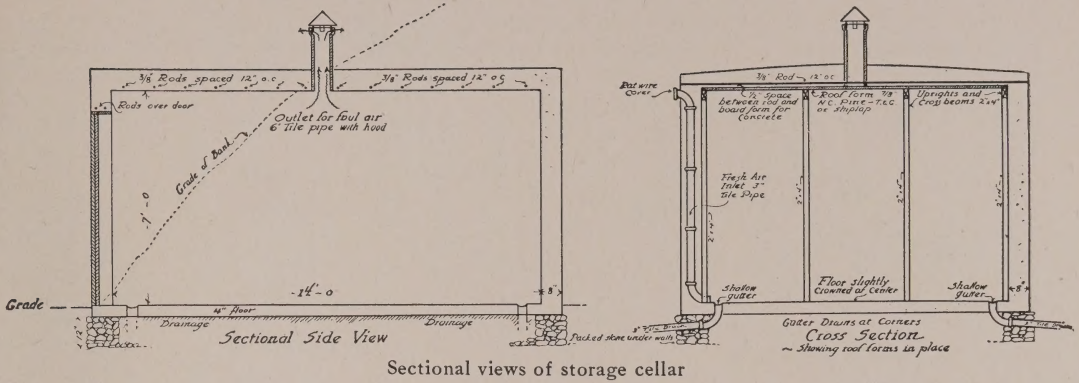
Root or Vegetable Storage Cellars

Accompanying sketches show in plan and longitudinal and cross section a concrete fruit or vegetable storage cellar 10 by 14 feet. A structure of this kind should preferably be located in a hillside or at one side of a knoll, and if so located



Concrete milkhouse

ALPHA CEMENT — HOW TO USE IT



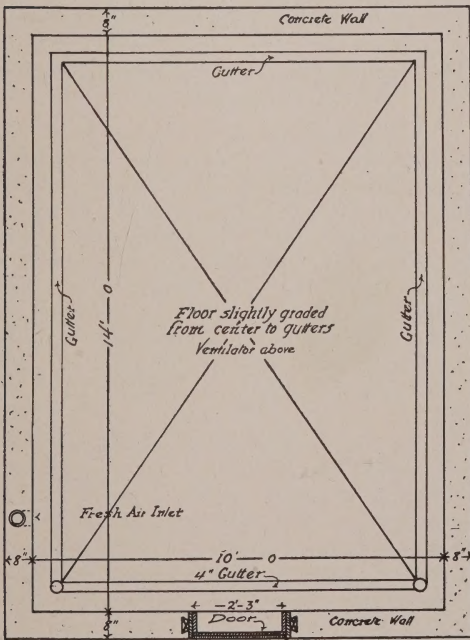
the necessary excavating will provide sufficient earth to bank the structure and cover the roof, which although not essential, is desirable to assist in maintaining an even temperature inside the cellar.

Although not shown on the plans, a structure of this kind should have reinforcing in walls, especially when set into the side of a hill or knoll, to prevent earth pressure from cracking the walls.

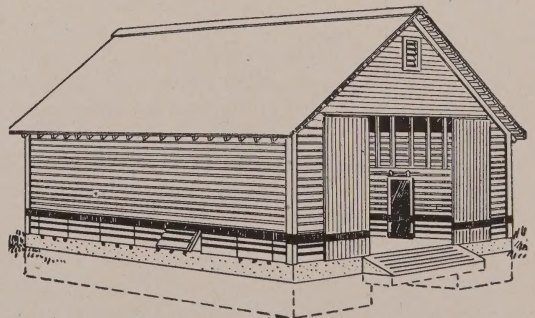
For a structure of this size 3/8-inch rods, spaced 18 inches center to center, will probably be sufficient. The sketches illustrate a system of ventilation, which is quite essential in such storage cellars to prevent dampness which would not be best for stored fruits and vegetables.

Ventilator pipes are of 6-inch concrete tile. The vents should be covered with galvanized wire mesh to exclude rats and mice. It is a good idea to lay a raised plank floor over the concrete one, and to divide the cellar into bins with 2-inch plank partitions, nailing planks 1/4 inch apart on 2 by 4 studs so that there will be ventilation all around the stored contents.

The roof of this structure also is reinforced with 3/8-inch rods, spaced 12 inches center to center in both directions. Another method of constructing this roof is to use metal lath stretched from dowel pins set into the concrete of the walls.

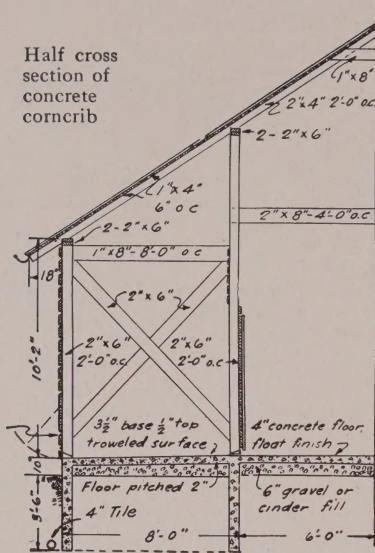


Concrete storage cellar



Good type of corner crib

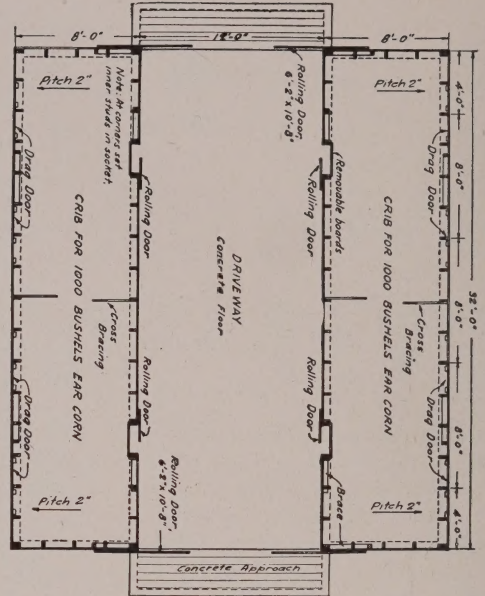
ALPHA CEMENT — HOW TO USE IT



Ratproof Corneribs

The accompanying designs show in plain, perspective and part section a ratproof cornerrib designed by the United States Department of Agriculture, in which ratproofness is secured by concrete foundation walls and floor and a fender strip that prevents the rats from climbing up side walls and thus securing entrance to the frame superstructure. The crib is a double one with a driveway between the two compartments, each of which has an estimated capacity of 1,000 bushels of ear corn. The driveway as well as the floors in the cribs proper are paved or floored with concrete. Construction of such floors has already been described under the heading "Walks and Floors." In setting up forms for the concrete floor in the cribs the form boards should be set so that the floor will have a slope of at least 1/4 inch to the foot for drainage if rain should blow into the crib during a severe storm. This slope should, of course, be toward the outside.

It is now possible to build corneribs of concrete throughout, several types of concrete cornerrib block having been perfected and commercial machines placed on the market to manufacture them. Such block have openings extending through them and slanting downward to prevent the entrance of rain. The block



is so made that a wall built of it can be reinforced by laying rods in the mortar joint, the principle being similar to that used in concrete block silo construction.

Concrete Smoke-house with Outside Fire-box

Accompanying sketch shows a suggested plan for a reinforced concrete smoke-house with fire-box placed outside of the building. The roof is shown as having a slight pitch, but if desired it can be made flat. In such a case it will not be necessary to embed timbers in the side walls to provide means for hanging up meat while smoking. Eye bolts can be linked around reinforcing rods in the roof and be embedded in the concrete of the roof.

The fire-box is so designed that in joining the smoke room there is a down draught, thus preventing the fire from burning too freely, and causing it to smoulder and smoke instead. Particular care should be used in selecting the aggregates of which the fire-box is constructed. The materials should be fire-resisting. See page 28. It would be well to use sheet iron lining for the fire-box, fitting this in place and using it as the interior form

ALPHA CEMENT — HOW TO USE IT

while placing concrete. Generally speaking, such a structure should be at least thirty days old before put to use.

Barns, Stables, Silos, etc.

The advantages of a barn of concrete construction are made apparent by what has already been said elsewhere about first cost, maintenance cost, proof against fire, vermin, weather and other deteriorating influences.

Barns may be built of block or monolithic concrete. The foundation walls should be 12 inches thick, following in construction the suggestions made in the chapter on Foundations, on page 58. Walls above ground for two-story barns should be not less than 10 inches thick.

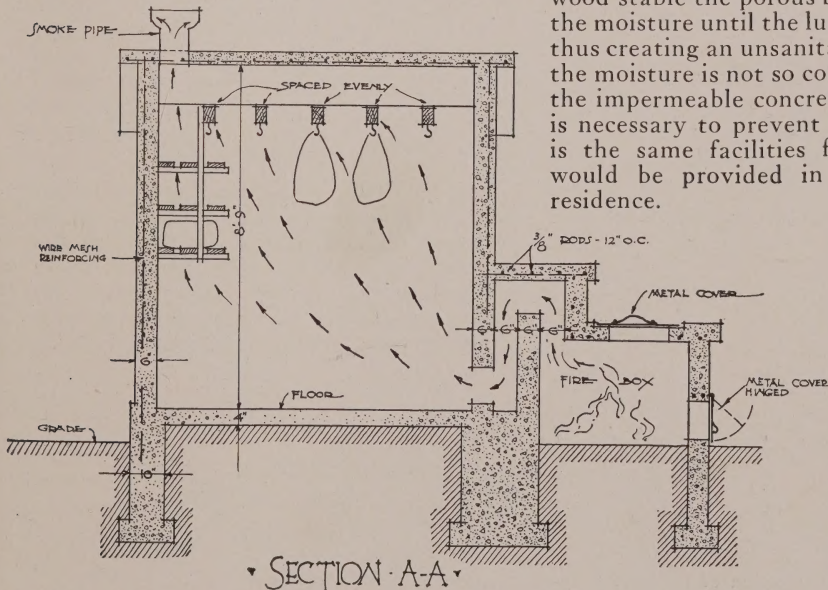
Floors should be built with care, as suggested elsewhere in this book. They should be 5 or 6 inches thick for one course construction. Where animals walk or stand, the surface should be finished with a wood float to give an even but non-slipping surface. Over-trowelling often causes checking. Barn floors should be laid in slabs not larger than 10 feet in any one dimension with joints extended clear

through the floor, to prevent unequal settlement or cracks caused by expansion.

The accompanying sketches show a good design for a general purpose barn. The arrangement of horse stalls excludes odors from the dairy barn proper, from the feed room and other dairy apartments. The second story has a fireproof concrete floor to protect the animals underneath should there be a fire in the hay storage.

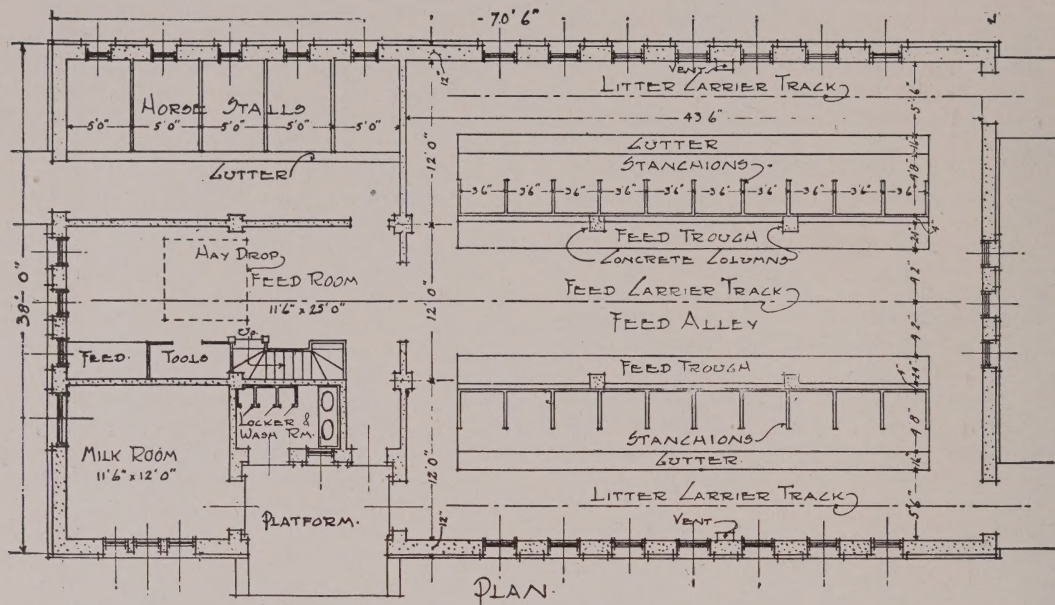
A concrete floor is not more likely to give rheumatism to stock than is any other type of floor construction. To bed animals well protects them from rheumatism on any floor. If one insists, of course, wood block may be laid over concrete to provide a wood floor, but it cannot be kept as clean as a concrete floor.

Frost or moisture will accumulate on the walls of horse or cow barns, whether of wood, concrete or anything else. These are signs of improper ventilation. Moisture accumulates in the stable air from the vapor exhaled by the animals. A mature cow throws off from the lungs about seven pounds of moist vapor per day. If the ventilation is such that this vapor is removed from the stable before it can be condensed on the cool concrete surface, the question of dampness is solved. In cold weather the vapor turns into frost as soon as condensed. In a wood stable the porous board walls absorb the moisture until the lumber is saturated, thus creating an unsanitary condition, and the moisture is not so conspicuous as upon the impermeable concrete wall. All that is necessary to prevent this condensation is the same facilities for ventilation as would be provided in a well designed residence.



Sectional view of concrete smoke-house with outside fire-box

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The accompanying plans provide good facilities for indoor lighting. The United States Department of Agriculture, Dairy Division, recommends 6 square feet of opening for each animal and gives 4 square feet as an absolute minimum. Windows should be placed near the ceiling and the height should be about twice the width.

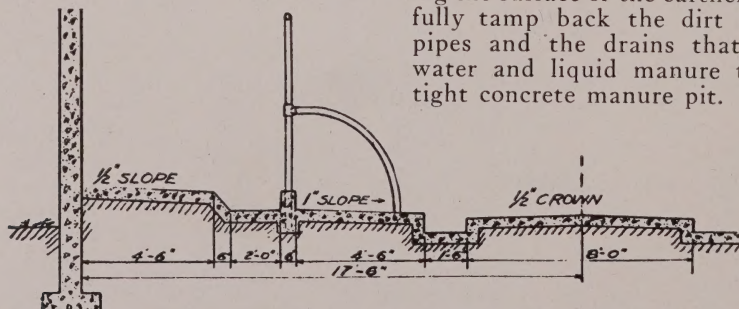
Concrete Stable or Barn Floors

If a barn floor is to accommodate two rows of cows standing heels toward each other, with a driveway between, lay out the stalls 3 feet 6 inches wide and 4 feet 6 inches in length from 6-inch manger

wall to drop gutter. The manger is 2 feet 6 inches wide at the top and 2 feet at the bottom, with one face sloping up to the feed alley floor; the depth is 7 inches measured from the stanchion setting, and 8 inches from the alley floor. The feed alley is 4 feet 6 inches wide.

The drop gutter has a width of 18 inches. It is 8 inches deep gauged from the stall floor, which is 2 inches higher than the 8-foot driveway. (See cross-section illustration.) For establishing grade lines a carpenter's spirit level (or a water level) and a chalk line are very helpful.

To prevent possibility of the floor settling, remove all manure before grading the surface of the earthen floor. Carefully tamp back the dirt around water pipes and the drains that carry waste water and liquid manure to the watertight concrete manure pit. Do all filling



Cross-section of concrete dairy-stall, showing usual dimensions

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as long as possible before building the concrete floor. As a foundation for the stall floors proper, place a 6-inch thickness of coarse broken stone or screened gravel to keep the floor from direct contact with the ground. As the stall floors are of first importance, it is well to make them first. During this operation the unpaved driveway and alleys can be used as working space. Then finish, in order named, the feed alleys, the driveways, the mangers and lastly the gutters.

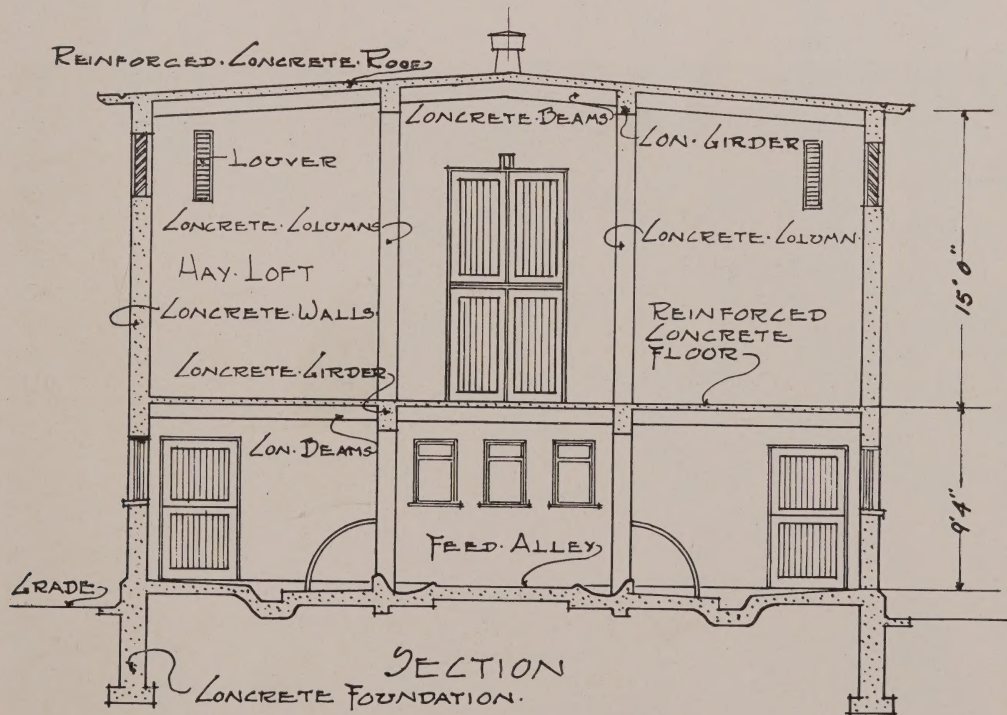
Mixing and Laying the Concrete. For the plan given, first place a stout board on edge and to line and grade 5 feet 6 inches from the center line of the driveway, this to serve as a form for the stall floor at the gutter. Likewise set a similar board, 5 feet distant, to mold the 6-inch manger wall and stanchion setting. Bear in mind that the stall floor is to have a slope of 1-inch toward the gutter and that the stanchion setting rises 7 inches above

the stall floor. Drainage for gutters and mangers will be provided by sloping their concrete bottoms.

At one operation lay the full 5-inch thickness of the stall floor and finish three stalls the same as one section of sidewalk. When patented stall divisions are to be used, follow the manufacturer's directions; for home-made divisions, make mortises or holes by tamping the concrete around greased, tapering wooden cores, which are withdrawn as soon as the concrete stiffens.

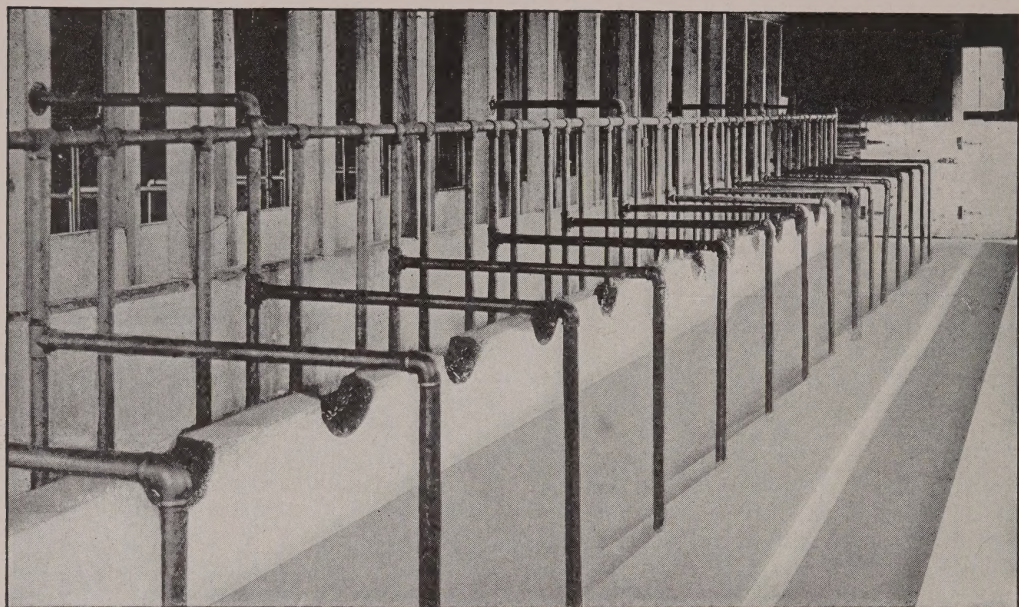
A wooden float is best for finishing the floor. A steel trowel yields a surface entirely too smooth, and such a finish should always be roughened by brushing with a stable broom.

While the concrete of the three stalls is still soft, mold the stanchion setting (6 inches thick) upon it. If 2 by 12 pieces are used for the first forms, the projecting 7-inch height of the form already in place may be used together with two 1 by 6-inch boards toe-nailed together so as to provide

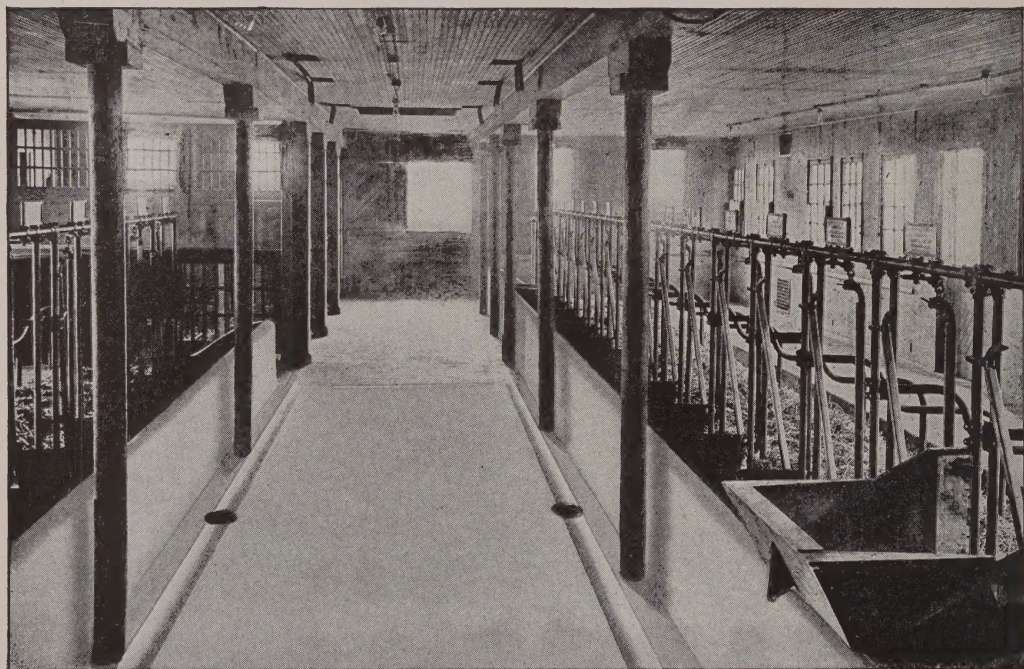


Combination cow-and-horse fireproof barn

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View in a model dairy when concrete replaced wooden floors



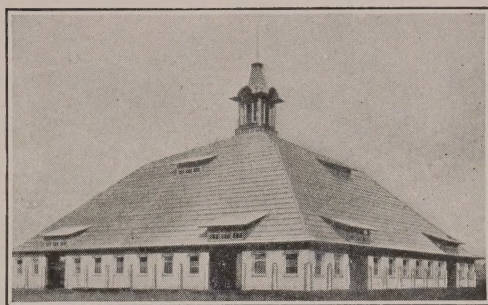
Model dairy barn, showing concrete feeding alley between rows of stanchions

ALPHA CEMENT — HOW TO USE IT

another 7-inch height and a bearing plate to rest on the fresh concrete. These forms may be made dish-shaped for swinging stanchions. Fill the forms with mushy wet concrete, trowel the surface, round the corners, and set the stanchion holders. Repeat the operation until all stall floors are completed. The feed alleys and driveway are easily built: they are merely rough-finished sidewalks. Place the waste-water outlets in the mangers at intervals of 28 feet and give the bottom a slope of 1 inch toward each outlet for a distance of 14 feet on each side of it. The drop gutters may be drained in like manner or can be sloped slightly in one direction for their full length. For ease in cleaning, round angles and corners.

Caring for Cattle and Floor. Regardless of the kind of floor, bedding of straw or litter is an absolute necessity: it keeps the cow clean and absorbs the valuable liquid manure. If the help cannot be depended on to bed the cows properly, it is advisable to use a removable wooden grating or platform. Cork bricks, set in a 2-inch depression of the cement, are sometimes used.

With the proportions and thickness given above, 4 bags (1 barrel) of cement, 10 cubic feet of sand (say $\frac{3}{8}$ cubic yard) and 20 cubic feet of crushed rock (about $\frac{3}{4}$ cubic yard) will lay 45 to 50 square feet of floor.



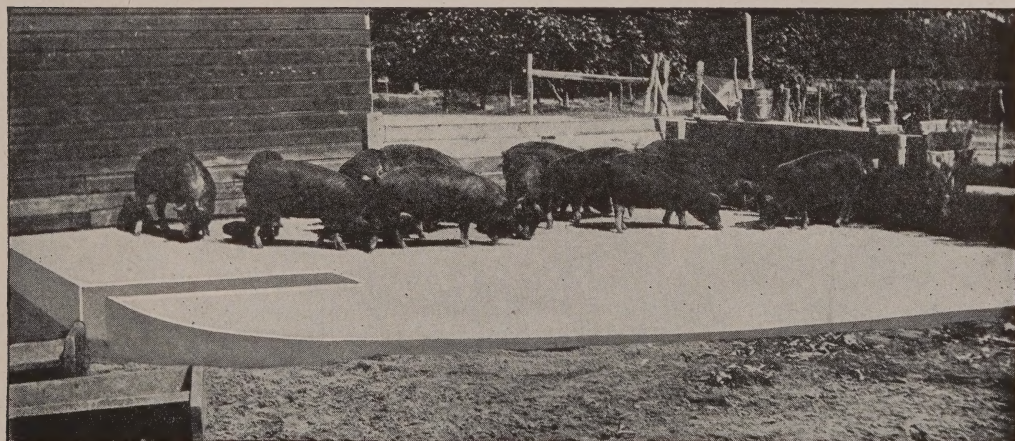
Sheep barn of Albert Peck, Geneva, Illinois. Largest of its kind in the State

Feeding Floors

When feed was thrown out on the old fashioned feeding lot, part of it was eaten and part trampled into the mud—wasted. Wood feeding floors were no improvement. They harbored rats and often became so unsanitary as to menace the health of the herd.

Concrete feeding floors which overcame all of these things, have been said by conservative men to be able to pay for themselves in a year where there is considerable feeding to be done.

Details of construction are similar to those described elsewhere under "Walks and Floors." The location should be one where drainage is good and if possible where the animals to be fed will be afforded protection from wind. The site



Concrete feeding floors save grain, labor and fertility. They quickly pay for themselves

James Stewart & Co., Inc.
Engineers and Contractors

Through the Galveston Hurricane Uninjured

THE first fears of Galveston in its recent great tropical storm were for the endurance of the sea wall and the tall structures. This great concrete grain elevator built with 22,000 barrels of ALPHA CEMENT by the Southern Pacific, stood sturdily through the tempest, though its basement was flooded and its window smashed by flying debris.

The sea wall, which is credited with saving Galveston from utter destruction, contained 28,500 barrels of ALPHA CEMENT.

Again and again ALPHA concrete construction has stood the most trying tests.



Burning of Wooden Structure
Replaced by the
ALPHA Concrete Elevator



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should be cleaned of all vegetation, and any soft spots dug out and refilled with gravel containing only a small amount of sand or with clean cinders free from ashes, and well compacted. Sometimes a sub-base is necessary as suggested on page 53. The floor should be sloped toward one side where there should be a gutter that is connected to a tile line leading to a manure pit so that all of the animal droppings on the floor can be preserved. In this way the concrete floor is made a two-fold source of profit.

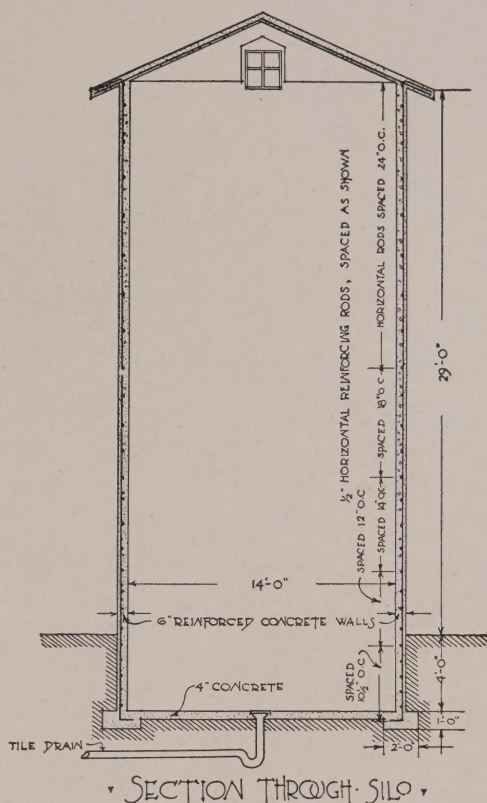
Feeding floors should be made preferably not less than 5 inches thick and of one-course construction, being laid in slabs no greater than 6 feet in one dimension (36 square feet in area). In finishing, one should use a wooden float instead of a steel trowel. The wood float finish largely does away with the possibility of hair cracking and leaves a gritty texture to the pavement surface that provides a good foothold. A concrete feeding floor should be washed off occasionally with broom and water, and in case of stock disease and the necessity for thorough disinfection the surface may be sprayed with gasoline and the gasoline set afire, thus making absolutely certain that disease germs will be destroyed.

A feeding floor should always be built with a curb around it extending two or three inches above the floor level to prevent the animals from shoving feed off the floor when eating. This curb should also extend a foot or eighteen inches below the bottom of the floor to prevent rooting under it.

Concrete Silos

Almost every farmer knows the advantages of the silo for preserving fodder, coarse hay, rape, vines, etc., so that winter feed may be succulent. The farmer who hasn't yet built a silo may be wondering which is the best type of silo for him.

Silo building is past the experimental stage. Of course, silage has spoiled in poorly built silos, and in silos of unsatisfactory materials. Silos themselves have dried out and been blown over; some were expensive to keep in suitable condition, and some were found after being built, to be unsuited to the owner's needs. These things will always happen so long as



wrong methods of construction and wrong materials are used.

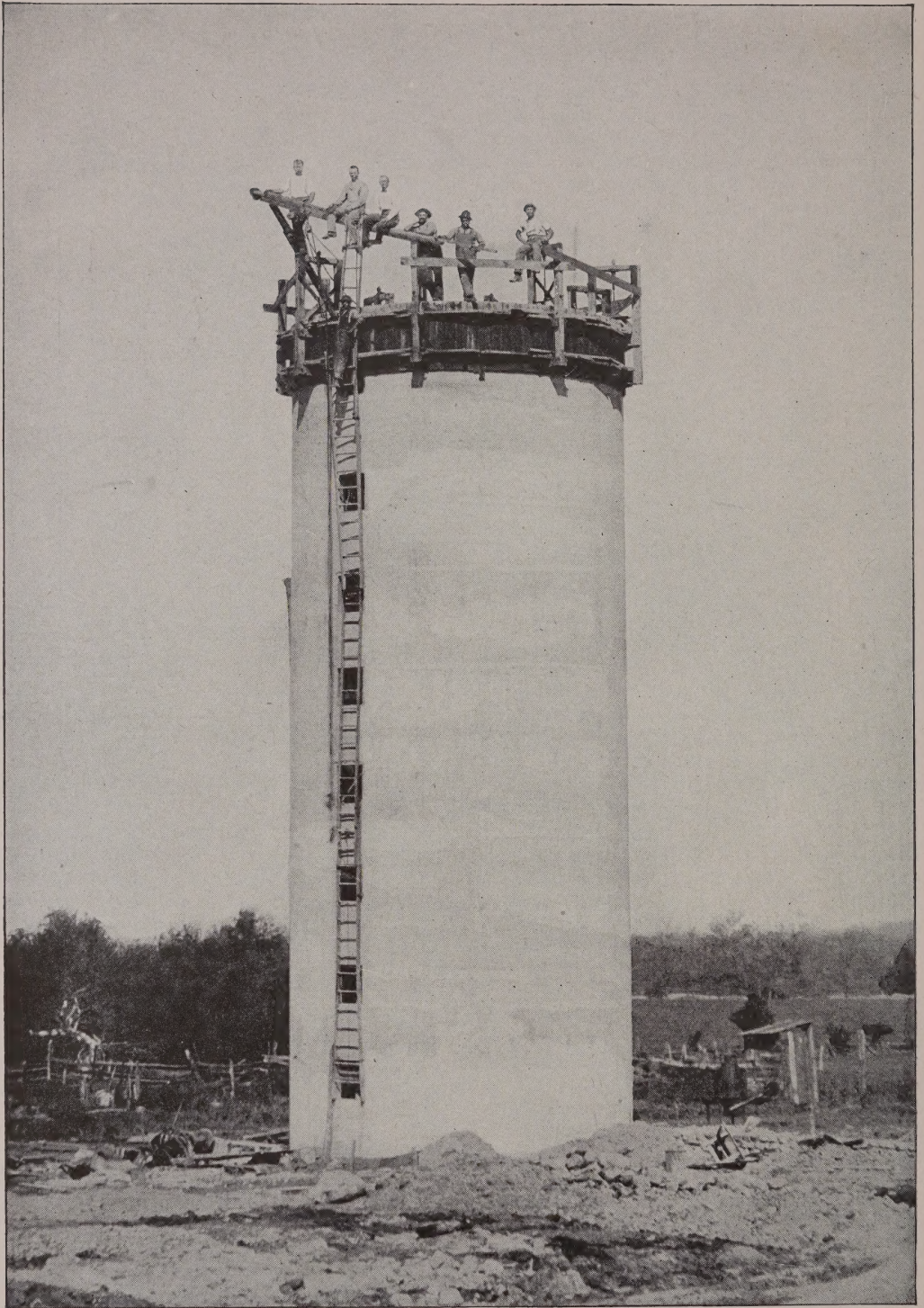
Concrete in a silo or in any other building can be made and kept airtight, rat-proof, waterproof and fireproof without the expense and with less depreciation than a structure of any other material so far known.

Concrete silos can be made in various types—of cement staves, concrete blocks or monolithic. All of these have desirable features, though the monolithic silo has peculiar advantages.

It is like one solid piece of stone, standing secure whether full or empty.

A concrete silo is fireproof. It is not at the mercy of lightning or neighbors' fires. A concrete silo is insurance against high feed prices for it retains fodder from one fresh-feed season to the next.

It is desirable, as a rule, to have a competent contractor with experience in concrete work build the silo. It is not impossible, however, for a farmer himself



An ALPHA silo, 18 feet in diameter, 50 feet high, on Woodlawn Farm, Avon, N. Y. Built October, 1911.

Mr. W. E. Dana, the owner, writes:

"It is in perfect condition. The ensilage has kept perfectly to the edge. The silo has been extremely satisfactory and is the cause of a great deal of favorable comment by visitors at the farm."

ALPHA CEMENT — HOW TO USE IT

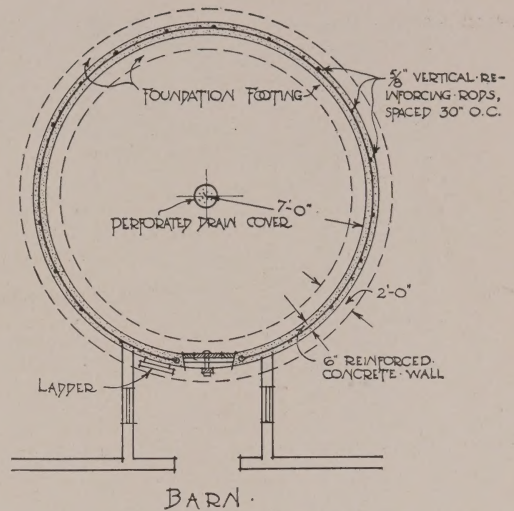
to build a small or medium sized silo of concrete. It is merely necessary that the established principles of good concrete construction be closely followed.

Excavating should be deep enough to bring the footings below possible frost penetration and rest them on a soil that is dense and firm. A drain is necessary in a silo. Provision should be made for placing it at time of excavating. It should be trapped to prevent the entrance of air which might tend to spoil ensilage.

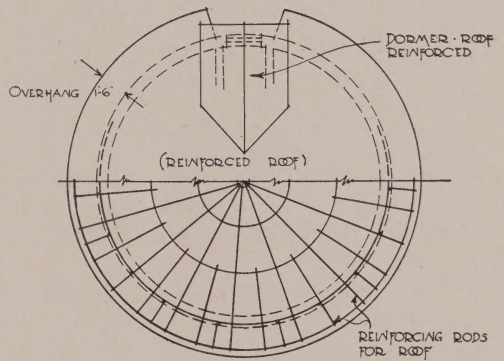
Reinforcing is necessary in a monolithic silo, according to its dimensions. Mesh fabric (usually called triangle mesh) or steel rods are generally used. The manner of using is explained in the chapter entitled "Forms and Reinforcement."

In the accompanying sectional drawings of a 14 x 31-foot silo, the horizontal section shows that $\frac{5}{8}$ -inch rods are used as vertical reinforcing. The vertical section shows that $\frac{1}{2}$ -inch rods used for horizontal reinforcing, are spaced varying distances apart. For instance The first five rods beginning from the bottom are spaced 10 $\frac{1}{2}$ inches center to center; the next are placed 12 inches center to center; the next 14 inches center to center, and so on, the spacing increasing as the upper portion of the silo is reached. This closer spacing at the bottom is necessary to take care of the increased pressure on the walls due not only to the weight of the silo but to the large amount of liquid that may be and usually is present in the silage; in fact, the monolithic concrete silo should be designed with a factor of safety that will provide for resisting the pressure of a quantity of liquid equal to half the capacity of the silo. The silage of some seasons is necessarily put into the structure while green and as it contains a large amount of water, this water pressure must be anticipated and provided for.

One very important detail of reinforcing is around and across doorway openings in the silo wall, through which feed is thrown. Such openings are usually enclosed by a chute of some kind which nowadays is made monolithic with the silo itself.



PLAN OF SILO



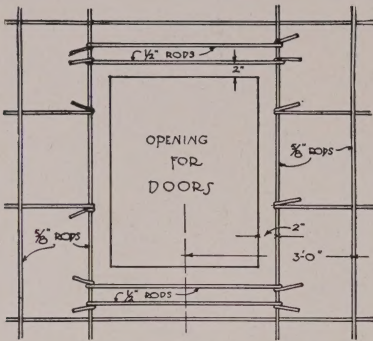
ONE HALF SHOWING REINFORCING FOR ROOF - OTHER HALF SHOWING DORMER ROOF LINES, ETC.

ROOF PLAN

However the doorways are made and whether enclosed or not, the effect of continuous horizontal reinforcing must be preserved across the openings. For more strength, an additional rod is usually placed vertically at each side of the doorway. A suggestion for tying in the break caused by doorway openings is shown on the next page.

Roof for Silo. Above is a plan of a roof and the scheme of placing reinforcing

ALPHA CEMENT — HOW TO USE IT

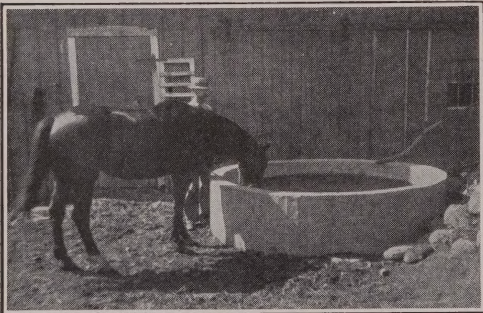


• REINFORCING AROUND OPENINGS •

ing. The quantity of reinforcing depends upon the area to be covered by the roof—the diameter of the structure.

Silo Wall Construction. The walls of monolithic concrete silos are almost universally 6 inches thick, commercial silo forms providing for this thickness. Thinner walls have been used successfully, but it is difficult in a thinner section to keep the reinforcing exactly where it belongs in the wall, also to spade the concrete while placing so that a smooth exterior and interior wall surface is obtained. Reinforcing in silo walls is preferably placed exactly $1\frac{1}{2}$ inches from the outer wall, but for convenience is usually placed at the center of walls.

Concrete must be thoroughly puddled or spaded in the forms, thus causing it to settle around reinforcement and make it possible when spading next to form faces to force back the coarse aggregate and produce a smooth surface finish to the structure.



Concrete watering trough made with silo form

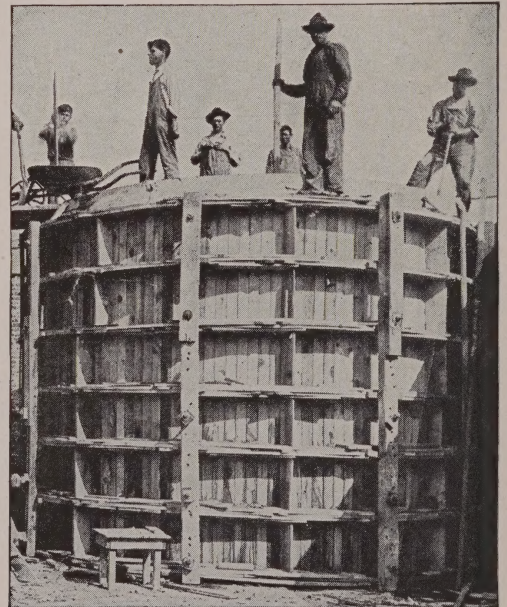
Other Important Details. When work on walls must be discontinued, the concrete in the forms should be left rough so that a bond may easily be secured between it and the fresh concrete when work is resumed. Before resuming however, the upper surface of the hardened concrete should be painted with a cement grout—a cement and water mixture of creamy consistency.

The inside of the silo also painted with this cement grout will give the walls a smooth finish, permitting close packing down of silage.

Leaks in a silo are accountable only by mis-steps somewhere in the course of building. See the chapter headed "Making Concrete Watertight," page 29.

If a silo is constructed in warm weather, it should be cared for as suggested under the heading of "Protection of Fresh Concrete." After forms have been removed, exposed aggregate or pebble pockets should be painted up with 1:2 sand-cement mortar.

Capacity of Silos. The size to build depends upon the number of animals to be



One type of removable forms for building silos. The forms are moved higher as the work proceeds

ALPHA CEMENT — HOW TO USE IT



Garage built quickly with a silo form

fed daily and the quantity of silage in pounds required for each animal, as well as the number of days it may be necessary to feed them. Dimensions of a silo should be fixed in accordance with the size of the herd so that a day's feeding will represent the use of not less than 2 inches of silage. This will prevent the molding of a thin top layer. The ordinary dairy cow re-

quires about 40 pounds of silage per day, and the following table gives suggestions as to the dimensions of silo to build for herds of various sizes and to provide for different terms of feeding based on the 40-pound daily ration.

The first cost of a concrete silo need not be higher than one of other material and of similar capacity. The maintenance

DIMENSIONS OF SILO ACCORDING TO SIZE OF HERD

NUMBER OF COWS IN HERD	FEED FOR 180 DAYS				FEED FOR 240 DAYS			
	Estimated Ton- nage of Silage Consumed	Diameter of Silo	Height of Silo	Corn Acreage Required at 15 Tons to Acre	Estimated Ton- nage of Silage Consumed	Diameter of Silo	Height of Silo	Corn Acreage Required at 15 Tons to Acre
	Tons	Feet	Feet	Acres	Tons	Feet	Feet	Acres
10.....	36	10	25	2½	48	10	31	3½
12.....	43	10	28	3	57	10	35	4
15.....	54	11	29	4	72	11	36	5
20.....	72	12	32	5	96	12	39	6½
25.....	90	13	33	6	120	13	40	8
30.....	108	14	34	7½	144	15	37	10
35.....	126	15	34	8½	168	16	38	11
40.....	144	16	35	10	192	17	39	13
45.....	162	16	37	11	216	18	39	14½
50.....	180	17	37	12	240	19	39	16
60.....	216	18	39	14½	288	20	40	19
70.....	252	19	40	17	336	..	..	..

ALPHA CEMENT — HOW TO USE IT

cost, however, is nothing for a concrete silo. It is proof against rats, mice and spoilage; it requires no paint or repairs.

If no contractor is obtainable and the silo must be home made, wood forms even though hard to build may be used. It would be better though if a group of farmers bought a commercial silo form, and after each farmer had his silo built, rented out the forms to others. Such forms can also be used to build round watering troughs, round milk houses, round smoke houses and ice houses.

Other Concrete Constructions

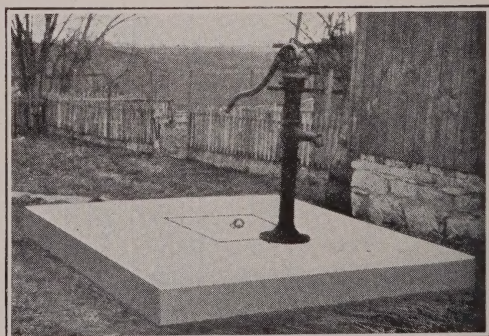
There are several methods of building a concrete well platform. The choice is dependent on the manner in which the pump barrel and stock are joined together. In the illustration is shown a platform 5 inches thick and 5 feet square, which contains a manhole fitted with a concrete lid. The pump stock passes through the platform by means of a circular hole at the side and a part of the manhole opening. By this means the pump stock and barrel can be joined together and slipped into position by a person working through the manhole. Afterwards the concrete manhole lid is set in place. Moreover, this lid is heavy enough that it cannot be removed by a child.

In preparing the well for a concrete platform, see that 4 or 5 feet of the curbing near the top of the well is of solid concrete, or of blocks or bricks laid up with cement mortar mixed in the proportion of 1 part cement to $1\frac{1}{2}$ parts sand. Carry the curbing 6 or 8 inches above natural ground level and grade the turf to this height so that surface water will flow away from the well. Prepare to mold the cover on a wooden platform of 2-inch boards laid over the well or placed on a level spot of ground. For most wells, a platform 5 feet square by 4 inches thick is sufficiently strong. To provide for a manhole opening, build a bottomless box, of 1 by 6-inch boards, 5 inches deep, 2 feet square at the top and 18 inches square at the bottom—outside measurements. Another plan is to have a tinsmith make

a round bottomless tin form 5 inches deep, 2 feet in diameter at the top and 18 inches at the bottom, after the pattern of a large bottomless dish-pan. To either manhole form attach a wooden block of the size and shape of the pump barrel or stock. Grease the manhole frame and set it on the wooden platform where the opening in the well cover is desired.

Have the concrete just wet enough to flush a little cement mortar when tamped into place. Over the entire wooden platform, except within the manhole frame, spread 1 inch of concrete. For reinforcing, immediately place on this concrete 5-foot lengths of $\frac{3}{8}$ -inch iron rods running in both directions (criss-cross) and spaced 9 inches apart. Bend the ends to a hook-shape. Strengthen the platform around the manhole opening by placing an additional rod on each side. Bring the cover to its full thickness at once by tamping in the remaining 4 inches of concrete.

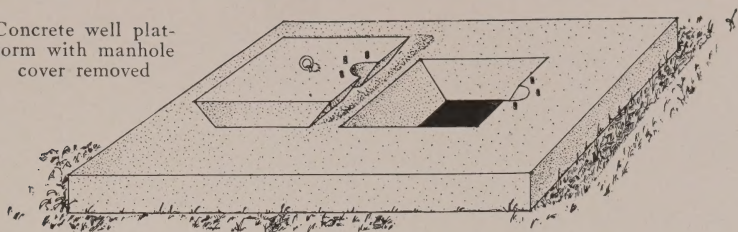
For fixing the base of an iron pump securely to the finished well platform, place in the soft concrete around the pump opening ordinary bolts (washers and heads down) to the depth of 4 inches. To locate these bolts correctly, set them by means of a wooden block or template in which holes have been bored and spaced exactly like those in the pump base. Lag bolts or similar devices may also be used for this purpose. Finish the surface of the platform with a wooden float, just as would be done in the case of sidewalks. If the greased tin form is used, the manhole cover may be cast at the same time as the rest of the floor. Reinforce the lid with



Sanitary well platform of concrete

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Concrete well platform with manhole cover removed

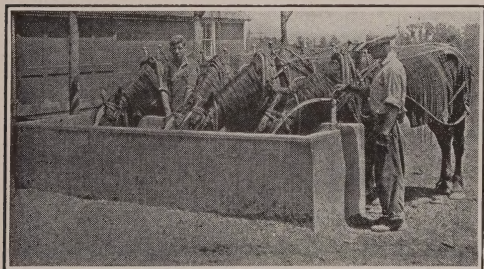


short lengths of iron rods laid criss-cross. As a lifting ring use half of an old bridle bit, or a hitching-post ring, the end of which is provided with a knob of twisted wire or with a nut and large washer. If the wooden manhole form is used, carefully remove it after four hours. One day later build the manhole lid the same as for the tin form with this exception—place greased paper or cardboard around the edges of the opening to prevent the new concrete from sticking to that of the platform. To make the manhole lid lighter in weight, before placing the concrete, spread $1\frac{1}{2}$ inches of wet sand over the wooden platform inside the manhole opening and then tamp in the concrete. Take care to place the reinforcing within 1 inch of the bottom of the manhole lid.

After the well platform is two weeks old, carefully remove the wooden boards on which it was built and set or lower it into place.

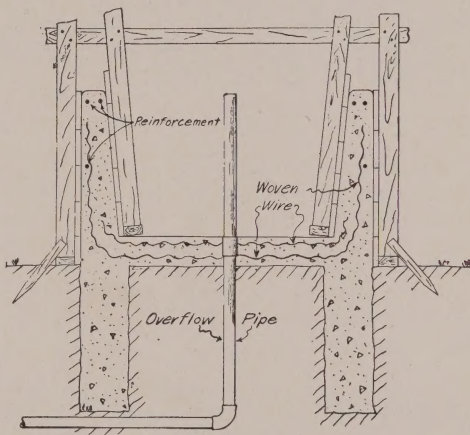
Feeding and Watering Troughs or Tanks

Concrete tanks or troughs are more easily kept in sanitary condition than those of any other material and they have a very decided advantage from the standpoint of permanence.



Good type of concrete watering trough

It is of course essential that tanks or troughs which are to hold liquids shall be watertight; see page 29. It is also necessary where possible to arrange for it, that the work be carried on continuously from start to finish so as to prevent construction seams in the work through which leakage could take place. See the chapter on "Forms and Reinforcement." If concrete is thoroughly spaded in the forms



Cross-section of concrete watering trough showing forms and tank with reinforcement

while placing, particularly next to form faces, the resulting surface will be smooth, dense and watertight and will need but little pointing up after forms have been removed. If a smoother finish is desired the whole structure can be painted with a cement grout paint.

A batter or slope should be given to the inside wall face of troughs and tanks so that in case the contents should freeze the ice will rise, thus relieving the tank from the pressure of expansion; otherwise they are likely to crack.

Small tanks and troughs can readily be cast upside down as shown on page 22,

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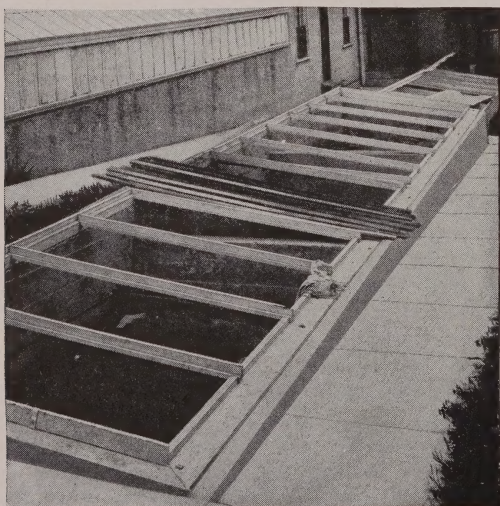
and when the concrete has hardened sufficiently to permit removing the forms they can be protected as suggested elsewhere for fresh concrete, and after ten days or two weeks may be carefully moved to the place where they are intended to be put to use.

In watering troughs or tanks such as are used in the barnyard or pasture lot, it is sometimes necessary to arrange for water inlet and outlet pipes passing through the floor or bottom of the tank. Provisions can be made for this when setting up the forms, as shown by the illustration on the preceding page.

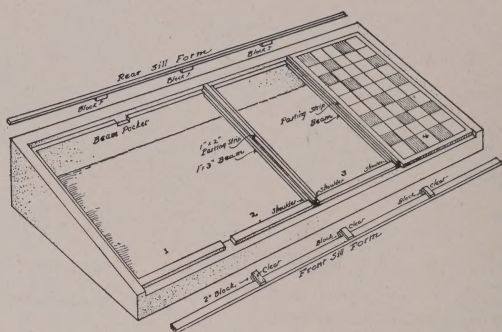
As in many other classes of concrete work, the best materials and workmanship will count for little or nothing unless the concrete is properly protected after being placed to prevent too rapid drying out and this is very important in connection with troughs or tanks, which if allowed to dry out rapidly would be porous.

Hotbeds

Most of the wood used in hotbed construction is in contact with the soil and rarely lasts more than two seasons, while if concrete were used such construction would be permanent and the slightly increased first cost would soon be compensated for by doing away with repairs and rebuilding.



Well located concrete hotbed



Perspective view of hotbed showing the last sash in place

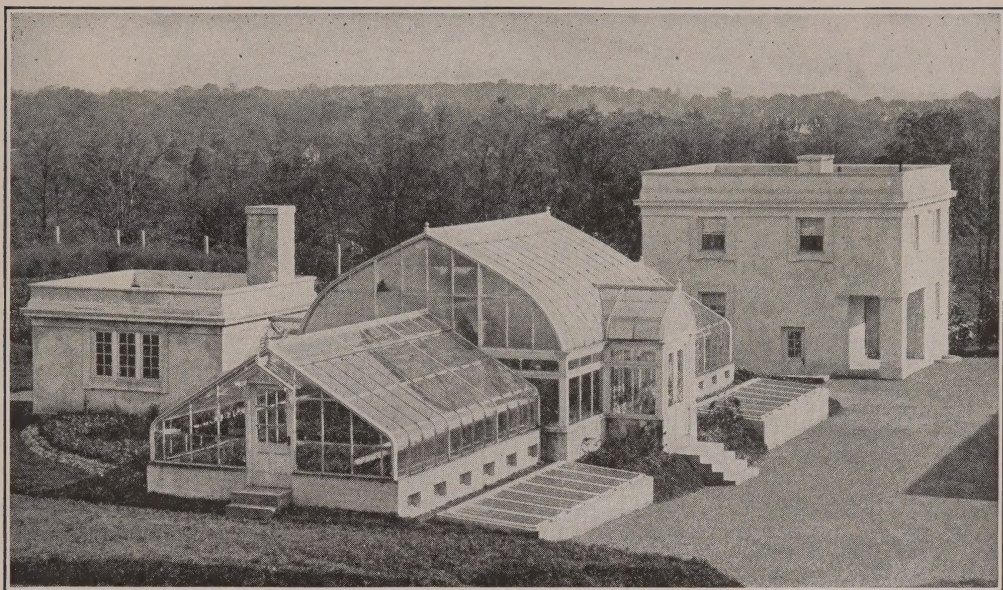
Usually concrete hotbeds require only the simplest of form construction, and where the ground is self-sustaining only an inside form will be required for the concrete work below ground level. At ground level, both inside and outside forms must be provided for the walls aboveground.

For hotbed construction a $1:2\frac{1}{2}:4$ concrete will be suitable. Walls should be from 6 to 8 inches thick with two $\frac{3}{8}$ -inch round rods bent to a right angle at each corner, these rods being 4 feet long and extending 2 feet into end and side walls. When finishing the back wall (which is the higher one) to provide for slope of sash, it is very easy to embed fastenings in the concrete for attaching sash hinges. A very convenient adjunct of the concrete hotbed is a two- or three-foot concrete walk on the low side, so as to make it easy to get around the bed during periods when the ground is wet. This feature considerably increases the ease and comfort of working in and around the bed. No stretch of concrete hotbed wall should be longer than 25 feet unless reinforced or unless the next section is completely divided from it by a contraction joint, as the expansion and contraction due to temperature changes in a stretch of hotbed wall longer than 25 feet is quite likely to result ultimately in cracks in the wall.

Greenhouse with Concrete Walls, Floors and Benches

In the hot, moist air necessary for cultivating or forcing plants under glass, wood construction soon goes to pieces from

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Attractive grouping of gardeners' house, workroom, greenhouses and hotbeds, at Greenwich, Conn.
(Lord & Burnham Co., builders, Carpenter & Blair, architects)

rot. This suggests concrete for all portions of a greenhouse which need not be of steel frame and glass.

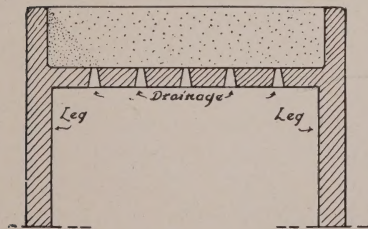
Accompanying sketches show in section a greenhouse with concrete walls, floors and benches, and detail of the benches or beds.

Walls for this structure may be from 8 to 10 inches thick, depending upon the weight of superstructure. Ten inches would be sufficient in extreme cases, 8 inches enough for all ordinary cases. Walls should start on a footing far enough below ground level to prevent disturbance from frost. Floors may be 4 inches—which is thick enough if no trucking is to be done

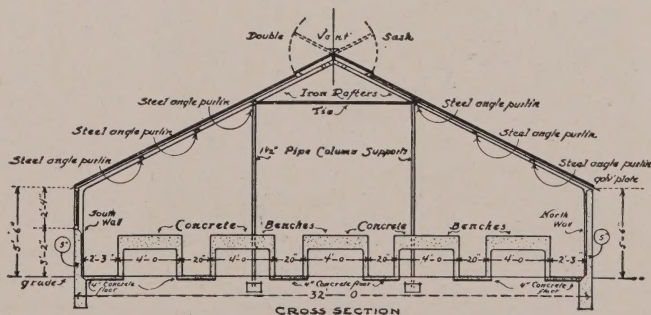
over them, but in the latter case an added inch would be preferable. Slabs should not be larger than 6 x 6 feet.

Although the benches shown in this design represent monolithic concrete construction, some prefer the sectional benches, which can be assembled or dismantled as desired. Sectional benches can be molded in spare time and erected when needed. Ordinary laborers with competent supervision, can make them. Earth can be rapidly shoveled from them. They do not deteriorate in or out of use, and afford no lodging for vermin.

The cost of a concrete bench 100 feet long and 5 feet wide, set up in place and



*Cross Section of Bench
Showing Drainage Device
Wilson-Hoyt Method*



ALPHA CEMENT — HOW TO USE IT

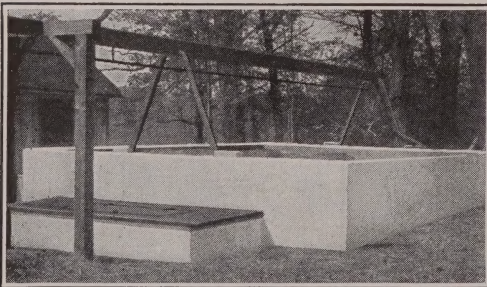
ready for use, should not under ordinary conditions exceed \$50. Unless firmly set, the monolithic bench may, as a result of settlement, crack, especially if not properly reinforced, while if the sectional bench is subjected to settlement none of the parts of which it is composed will be injured. It is also unnecessary to provide special drainage facilities in the sectional bench, while in the monolithic type, some form of perforations must be provided in the base or floor of the bench to permit drainage and proper aeration of the soil.

In a concrete greenhouse, there is no rotting or fungus growth, which may bring on plant diseases. Concrete floors and benches are easily cleaned by washing.

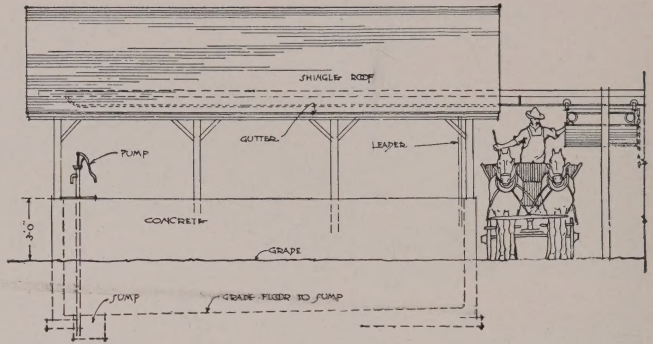
Manure Pits

Concrete construction is ideal for the proper handling of manure until it is convenient to haul it out to the fields. Every particle of the liquid content, which contains the greater proportion of the fertilizing elements, can be preserved and restored to the soil.

Usually a manure pit is constructed in some manner after the accompanying sketches, that is, either with or without a roof, and with a sump or cistern into which the liquid contents will drain and from which they can be pumped for sprinkling on the land when convenient.



Manure pit on farm of Haverford College (Haverford, Penna.), constructed with ALPHA CEMENT. In front is tank from which liquid manure is pumped



Side elevation of good form of covered pit

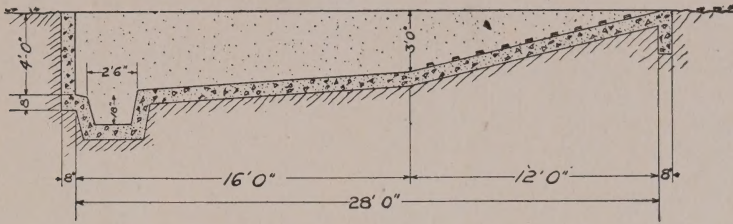
In the chapter headed "Forms and Reinforcements" may be seen additional details of its construction. It is quite desirable to roof the pit and screen it with fly screen fabric, to prevent the manure pile from becoming headquarters for fly breeding. This is especially true on the dairy farm, where milk must be cared for in a sanitary manner, which means keeping flies down to a minimum.

Manure pits should be conveniently located with reference to the barn so that if desired litter can be carried directly from the stable to the pit by a litter carrier, as shown in two of the accompanying views. The inside wall face of the pit should be sloped and all corners slightly rounded so that the manure can be properly packed in the pit to thus regulate or control decomposition. Some pits are built without a wall at one end and the floor sloped upward to ground level so that a wagon can be backed in for loading. In most cases a relatively shallow pit is best; that is, one where the manure cannot be piled to a greater depth than 3 feet. Where the pit is built almost entirely above ground, two $\frac{3}{8}$ -inch horizontal rods spaced 12 inches apart, commencing 4 inches from the top of side walls and extending all around the structure, may be embedded in the concrete for the purpose of preventing cracks due to temperature changes, particularly at corners.

Septic Tank

Wherever a residence can be connected to a city or town sewer system this is, of course, the ideal way of disposing of house

ALPHA CEMENT — HOW TO USE IT



Sectional drawing of shallow concrete manure pit

wastes. But in small communities and on the farm where houses cannot be so connected, it becomes necessary to devise some safe and inoffensive way of taking care of house wastes. Cesspools are unsafe and unsanitary even when handling waste from house plumbing, as their very environment is often favorable to a rapid multiplication of disease germs. Furthermore, if the cesspool is not walled in so that the structure is leak-proof, the wastes are quite likely, sooner or later, to contaminate a nearby well which is usually the source of domestic water supply. And even if walled in so that contents cannot seep from it, cesspools must be pumped out periodically—an unpleasant and very offensive task.

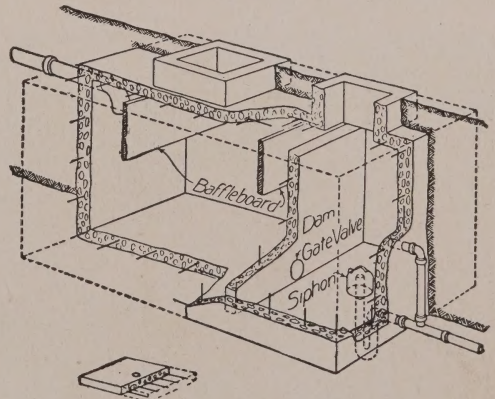
Modern sanitary science has developed for the isolated home the septic tank, which preferably should be built of concrete. Many persons have built structures which they thought were septic tanks but in reality were nothing but cesspools through which the sewage passed continuously and with but little alteration. Every septic tank should have at least two compartments, one of these being a sort of settling or digesting chamber in which the sewage is held for a certain length of time and where it undergoes a preliminary decomposition owing to the action of certain bacteria which takes place in this compartment if it is kept practically air and light tight.

An accompanying design shows an approved form of septic tank. Concreting details of this work are not unlike those of ordinary tank construction, the difference being that the structure has a roof or cover slab. This can be built several days after the side walls have been finished, and the vertical reinforcing rods can be allowed to project far enough above the concrete of the side walls so that

projecting ends may be bent over and form a part of the reinforcing for the cover slab.

As a rule the first compartment should not be less than 6 feet deep, and its size should be planned so that the capacity will equal 50 gallons per day for each member of the household to be accommodated. Baffle boards shown in this first compartment are for the purpose of preventing any disturbance of the scum or sludge that forms in this compartment after bacterial action is started. This scum must not be allowed to pass from the first to the second compartment, for the latter contains an automatic device known as a siphon which periodically empties this compartment and allows the contents to be distributed to tile lines or open ditches, adopted for final disposal.

A concrete septic tank must, of course, be watertight; see page 29. As in other tank construction, concrete must be mixed to quaky consistency and be well spaded in the forms. After side and partition walls have been built, studs are set up and a floor built for supporting concrete



Sectional view of concrete septic tank

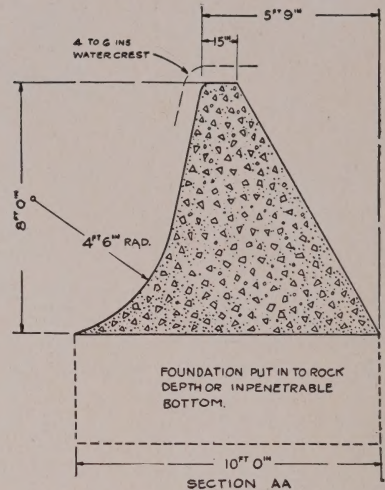
ALPHA CEMENT — HOW TO USE IT

for the roof or cover slab. A bottomless frame is set on this platform at the point desired for manhole openings, these manholes being for the purpose of providing access to the compartments when necessary to clean out the tank, which usually is not required oftener than once a year. Side walls and cover slab should be properly reinforced with steel rods spaced in accordance with the requirements, depending upon the size of the tank.

Before deciding to install a septic tank or before building one, consult either the state or county board of health, so that competent advice may be obtained as to the type of tank and final disposal system suited to local conditions. A great deal of the success of the septic tank depends upon a wise choice of the method of final disposal, and this choice is often influenced by the amount of land available for the purpose. Where possible to do so, two or even three disposal fields are better than one, allowing one of the disposal beds to rest for several days or longer, if necessary, while the other is caring for the discharges of the tank.

Concrete Dams

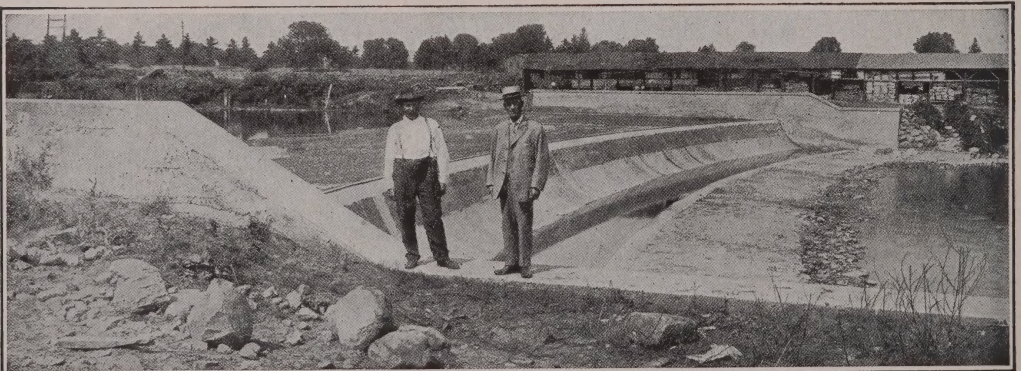
A small dam on many a farm would help to form a pond from which the home supply of ice might be harvested. Then too, such ponds may be used for fishing, swimming, rowing, etc. In many other places there are streams carrying a reasonable volume of water which if permanently dammed, could be made to do profitable work if means were available to harness this power. Of course the design of such



Section of concrete dam

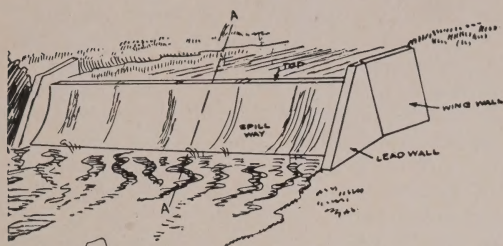
structures depends much upon conditions at the actual site of the work. This must be understood as referring to the small dam, such as is shown in accompanying perspective and sectional drawing.

Dams must be heavy enough and sufficiently anchored to oppose a force of water standing against them, to prevent being moved from their foundations or from being toppled over. A dam must be so designed that the flow of water over the crest will, when falling down the face, strike in such a way as to be deflected and at once directed downstream. This is accomplished by shaping the face to a curve that deflects the water into the stream bed, or by building an apron on



Good style of construction

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Perspective view of concrete dam

the lower part of the dam to prevent the falling water from pounding at the base and weakening or undermining the foundation.

Sometimes dams are destroyed by the freezing of impounded water and unless exceptionally massive construction is used, reinforcing is necessary to prevent injury from the stresses caused by the expansion when ice forms in the pond.

In the best types of construction, the upper face of the dam is battered, that is, sloped so that the ice will rise when forming and thus relieve the dam from the pressure of expansion.

For ordinary small dams such as might represent construction on the farm, the concrete mixture used should be a 1:2:4. In most cases the home worker will find it inadvisable to attempt the planning and construction of a dam. Some competent engineer should determine foundation conditions and requirements and suggest or design ways and means of anchoring the dam. In some cases dams have been built in a manner similar to walls of buildings, these walls being reinforced and braced against overturning at intervals by reinforced buttresses; in fact, many large structures have been built in such independent units.

Rollers of Concrete

Rollers were originally made from logs of wood. These were abandoned for the more expensive iron rollers. To-day these are being largely replaced by concrete rollers. An iron roller with a cylinder from 2 to 3 feet in length will cost from \$15 to \$20, whereas one of the same size constructed of concrete should cost much less.

Obtain a length of sewer pipe, of the size of roller desired. A tile from 12 to 24 inches in diameter will usually suit the purpose. Set this tile on end, small end down, on a wooden platform. Through a hole bored in the platform insert a 1 inch round iron bar, long enough to project beyond the ends of the roller a sufficient distance to provide bearings and attachment for the handles. Care should be taken to get the bar exactly in the center of the tile before placing concrete, and to keep it there while the concrete is being placed. Make a wet mixture of concrete and fill the tile with this mixture, up to the "bell" of the tile. Allow the concrete to set for ten days, when the roller may be placed on side, and the bell of pipe chipped off with a cold chisel and hammer. Attach a forked handle as shown in the illustration. As the axle is a firmly-fixed part of the roller, the fork ends of the handle must be provided with holes, within which the axle can turn.

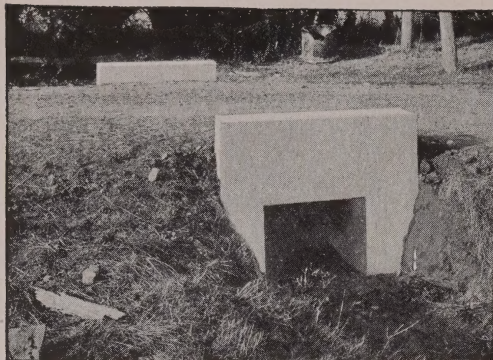
A roller 18 inches in diameter and 2 feet long will weigh about 600 pounds. If a lighter roller is desired, use a smaller sized sewer pipe; or place several small pipes inside the large one, depositing the concrete around them on the outside. They will form hollow spaces inside the roller and lessen its weight.

By increasing the size of pipe, or by using a steel mold and attaching a pair of shafts or a tongue instead of a handle, horse rollers may be made for crushing the clods in the ploughed fields.



Concrete lawn rollers are easily made

ALPHA CEMENT — HOW TO USE IT



Concrete culverts may be made square or round

Permanent Culverts

The secret of good roads is good drainage. Standing water soaks into the road bed, softens the road surface and causes ruts. To keep well made roads in first-class condition, get the water to the highway drain tile as fast as it falls. This can be accomplished only by means of culverts.

The perfect culvert is one which does not rot or rust out, which does not crush down and clog up the opening, and which lasts forever. Concrete is the only material which fills the bill.

The best time to build a culvert is in the dry months of summer. They can be shaped either round or square and of a size depending on the amount of water

which must be removed quickly. Usually openings 12 to 18 inches are large enough. Set the culvert as deep in the road bed as possible, but do not place the outlet end lower than the bottom of the ditch into which the culvert drains. To keep the culvert well beneath the road bed, if necessary, make the side ditch deeper at the inlet end. Determine the grade line of the finished culvert bottom. Only a little slope is needed. Dig the trench 6 inches deeper than the grade line and as wide and long as necessary. The width of the trench depends upon the size of the culvert to be built, and its length upon the width of roadway under which the water is to be carried. The concrete walls are each 6 inches thick, so the width of the trench will be 1 foot greater than the clear width of the culvert. Fill this trench with concrete and while it is still wet place in the center of it a U-shaped box of one-inch boards, turned upside down, the outside of which is the size of the culvert desired. Fill concrete into the space between the sides of the box and the sides of the trench and tamp concrete over the top to a depth of 8 inches. Road culverts should not be less than 18 inches below the surface of the roadway.

To prevent the material of which the road is made from washing down into the culvert, small wing or retaining walls

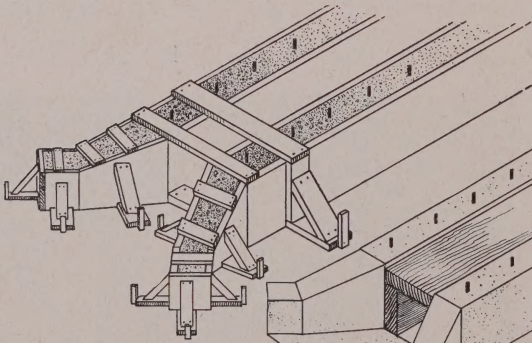


Figure 1

View of Culvert showing construction of wall forms and bracing. Iron dowels are shown placed at intervals to carry metal lath reinforcement shown Fig 2. When wall forms are removed, a 3" concrete buffer is laid before work on top member is commenced.

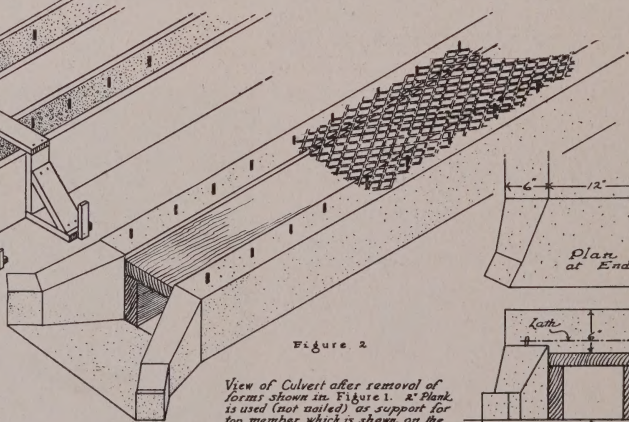
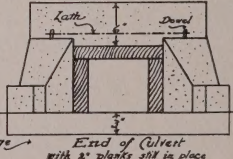
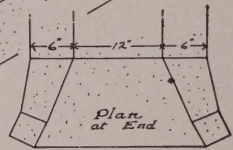


Figure 2

View of Culvert after removal of forms shown in Figure 1. 2" plank is used (not nailed) as support for top member which is shown on the right.

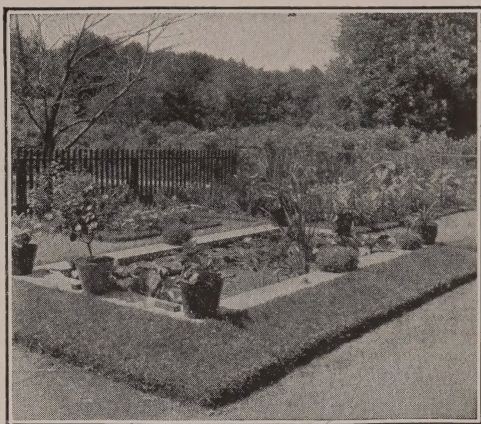


Methods of building another good style of square opening culvert

ALPHA CEMENT — HOW TO USE IT

must be built at each end. To do this dig an 8-inch trench 3 feet deep, at each end of the culvert along the end of the culvert barrel. Frame a form, the width and height necessary, against the end of the box or pipe. Make another form, of the same size, but U-shaped, with the opening just large enough to fit over the outside of the concrete culvert barrel. Set this form 8 inches inside the first. Plumb both forms and brace them securely. Nail boards across the ends of these two forms and fill them with concrete. For one week shut off the traffic from passing over the culvert. Allow the forms to remain in place for two weeks. Replace the road material over the culvert and keep the ruts carefully filled until the fill has become solid. Since there are usually many culverts to be built, it is cheaper to use a collapsible form, adjustable to several sized culverts.

The box culvert shown at the top of page 84 has an opening 18 inches wide and 16 inches deep. The length is 20 feet. The retaining walls are 8 inches thick, 2 feet high (from the barrel opening), and do not extend beyond the culvert walls. The bottom and the side walls are 6 inches thick; the top, 8 inches. Three men, with a highway commissioner as superintendent, built this culvert in two days.

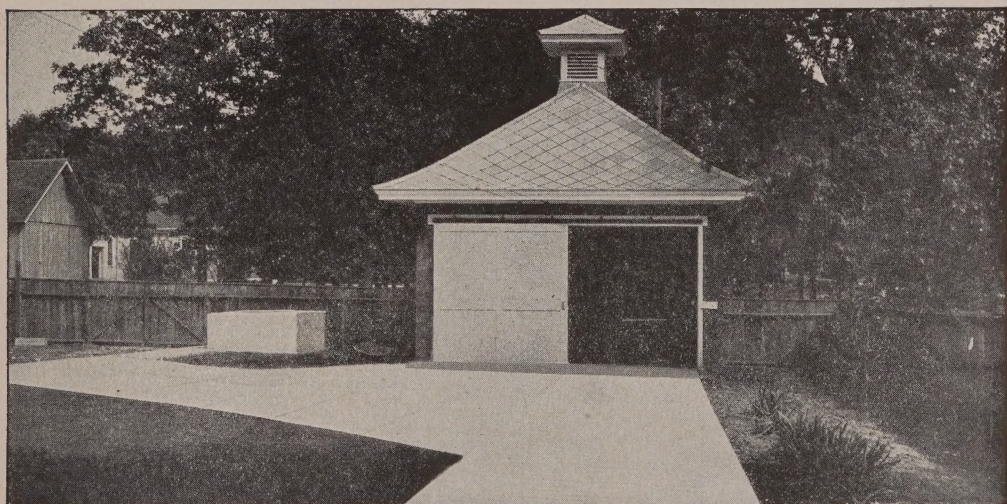


Concrete pool for water-lilies

Facts About Concrete Roads

The concrete road is the natural evolution of the macadam road—an evolution brought about by changed traffic conditions.

The macadam road depended upon the abrasion of steel-tired traffic to form a limestone dust which, when wet, constituted the binder. The automobile, with its whirring rubber wheels, removes this binder and sends it off in clouds to fertilize the fields along the road. Result: the disintegration of the macadam road.



Concrete driveway with platform for washing automobiles. Note the concrete garbage box at the left

Some Everlasting **ALPHA** Roads

Concrete for Permanence



Sugar-Notch Concrete Road
near Wilkes-Barre, Pennsylvania

Clean and dustless; even but not slippery; unaffected by heat, cold, freeze, or thaw; no binder to wash out or to be ground out by whirling automobiles — the concrete road remains in good order 365 days of the year, and being practically wear-proof, is the best road investment a community can have.

ALPHA PORTLAND CEMENT COMPANY

General Offices: Easton, Pa.

New York Philadelphia Boston Pittsburgh Baltimore Savannah

Connecticut First Concrete
Road between Terryville
& Bristol



Concrete Highway
Ilien, New York

ALPHA The Hourly Tested
Guaranteed Portland **CEMENT**

ALPHA CEMENT — HOW TO USE IT

Many other binders, such as asphalt, coal tar and other bituminous, rocmac, glutrin, etc., have been tried in varying combinations and with varying success. Moisture and the swift traffic of modern times make repairs necessary soon and frequently.

Portland Cement is the most tenacious and enduring binder known today—the only one that produces a road that can really be called permanent.

A concrete road is high-grade stone held into place, on a good, well-drained subbase, with this strongest of all known binders—Portland Cement. Finer aggregate—sand—is used to fill the voids in the coarse aggregate. Nowadays mesh reinforcing is generally used. But the kernel of the nut in road-making is *the binder*, and there is no substitute for Portland Cement in strength and permanence.

Costs. A waterbound macadam road costs approximately \$1 per square yard if it is built as it should be. The maintenance cost on macadam roads in the states exceeds \$800 per mile per year.

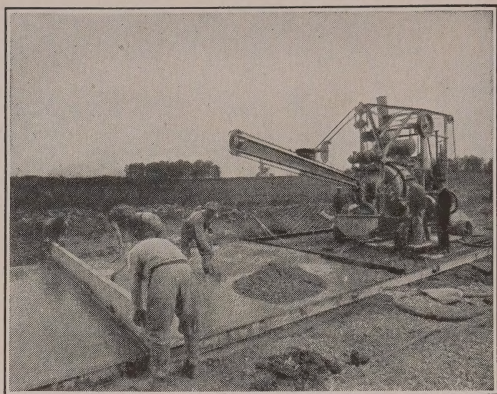
The real cost of an improvement is measured by the service which it yields in proportion to the money invested in it.

A concrete road costs, on an average, \$1.25 to \$1.30 per square yard, and maintenance costs, in sections having 50 to 100 or more miles of these roads, are below \$50 per mile per year.

Costs in 5-Year and 10-Year Periods. Taking the foregoing figures, and considering that there will be no maintenance cost on concrete roads the first year, the real cost of the two roads (macadam and concrete) is approximately equal at the end of five years, that is, \$13,200 per mile. It is generally conceded that a road must have a good subbase and be well drained, if it is to last any reasonable time, no matter what the type; and this expense should always be figured on.

The macadam road with its increased maintenance will cost more every year and will soon have to be replaced. The concrete road grows stronger with age and maintenance costs are practically negligible.

Below are some extracts from bulletin No. 136 of the Office of Public Roads,



Laying a concrete road

U. S. Dept. of Agriculture, on the subject of Highway Bonds.

"It is generally accepted that roads built with surfaces entirely of concrete or with a brick pavement and a concrete foundation are permanent.

"If the road surface is built with the proper mix of concrete and carefully placed it apparently should last indefinitely and not rut.

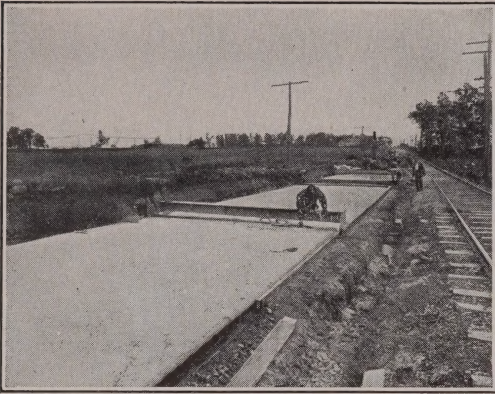
"The sum of \$525 per mile, on an average, should therefore absolutely maintain macadam roads if changes and increases of traffic are not excessive.

"It is clear, therefore, that \$700 per mile is not an excessive estimate at present for the annual cost of all repair and maintenance of bituminous-macadam roads.

"The cost of all maintenance and repair over a series of years has ranged in the past from 6 to 10 per cent. of the original cost of construction on the average, and varies with the type of construction. Concrete roads and brick roads apparently are a marked exception to this rule."

The Concrete Pavement. A concrete base is now considered necessary for all types of municipal paving. In order to have a permanent brick pavement it is necessary that it be laid on a concrete base with concrete grout between the bricks. When laid in this manner, however, it becomes the most noisy roadway known. On the other hand, if the brick is laid on a sand cushion, it seems to be

ALPHA CEMENT — HOW TO USE IT



Putting finishing touches on Easton-Allentown concrete highway

almost impossible to get this cushion uniformly distributed over the entire surface; the result is that very quickly the road develops hollows and holds water. This latter condition is very much more apparent when, as is done sometimes, the brick is laid on sand directly on the clay or earth after the road has been properly graded. The first method mentioned of constructing such a road is very expensive.

The greatest expense in paving is incurred by the construction and maintenance of the surfacing. By improving the base at a comparative slight increase in expenditure an ideal pavement is secured which requires practically no maintenance.

The requisites for an ideal pavement, in order of importance, are:

Durability, Cheapness, Low Tractive Resistance, Ease of Cleaning, Sanitary Qualities, Ease of Maintenance, Non-Slipperiness.

The concrete pavement fulfills all of these essentials better than any other known type.

Concrete is superior to all types for alley paving. It is low in first cost, water drained on the surface does not injure it, and it can readily be kept clean.

Effect on Horses. Horses are injured not by hard roads, but by those full of small holes, with loose stones on the surface. A concrete road, though hard, always presents an even surface which pre-

vents wrenching of horses' knees and shoulders.

Horses slip forward or backward and sidewise. Veterinary surgeons say the side slip is by far the most harmful. The slight crown and the gritty surface of a concrete road prevent side slipping of horses, and skidding of automobiles.

The ease of pulling, the even surface upon which the horse places its hoofs, and the non-slipperiness are distinct advantages which a concrete road possesses over that of any other type. Horses can draw a much greater load on concrete than on any other kind of road.

Noisiness. A road built of any hard material is noisy but there is no objection to this in the country. In city streets concrete is no more noisy than brick, granite block, or asphalt in cold weather.

Properly constructed concrete roads rarely crack. Cracks, however, if cleaned out and kept filled with bitumen and sand, are no detriment to the road except as they affect its appearance.

The exposure of the aggregates under wear prevents glare.

Concrete roads are never dusty. They wear only about $\frac{1}{16}$ of an inch a year.

The weight of traffic is concentrated on very small areas of the road surface. A road must be strong enough to support the weight of the traffic.

Concrete roads are not affected by weather, traffic or foreign material tracked upon them.

Alternate freezing and thawing has no effect on cured concrete.

Heat does not soften the binder, permitting it to flow.

Cold does not make it brittle, permitting it to chip.

Roads of gravel and macadam require a high crown.

Concrete roads are made nearly flat, as water runs off them easily.

The slight crown brings the entire width of the road into use.

There is no tendency to drive continuously in the middle of the road. The wear is therefore distributed over the entire surface.

Special literature on concrete roads, giving further data, will be sent free on request.

ALPHA CEMENT — HOW TO USE IT

Standard Specifications

Definition—1. Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and proper proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

I. Chemical Properties

Chemical Limits—2. The following limits shall not be exceeded:

Loss on ignition, per cent.....	4.00
Insoluble residue, per cent.....	0.85
Sulfuric anhydride (SO ₂), per cent...	2.00
Magnesia (MgO), per cent.	5.00

II. Physical Properties and Tests

Specific Gravity—3. The specific gravity (the specific gravity test will not be made unless specifically ordered) of cement shall be not less than 3.10. Should the test of cement as received fall below this requirement, a second test may be made upon an ignited sample.

Fineness—4. The residue on a standard No. 200 sieve shall not exceed 22 per cent. by weight.

Soundness—5. A pat of neat cement, after 24 hours in moist air, when immersed in steam, shall remain firm and hard, and show no signs of distortion, cracking, checking or disintegration.

Time of Setting—6. Initial set shall develop in not less than 45 minutes when the Vicat needle is used or 60 minutes when the Gillmore needle is used. Final set shall be attained within 10 hours.

Tensile Strength—7. (a) Test pieces of standard mortar composed of one part cement and three parts standard sand, by weight, shall give tensile strengths equal to or higher than the following:

Age at Test Days	Storage of Test Pieces	Tensile Strength lb. per sq. in.
7	1 day in moist air, 6 days in water	200
28	1 day in moist air, 27 days in water	300

(b) Each value shall be the average of the results of tests from not less than three test pieces. The tensile strength of standard mortar at the age of 28 days shall be higher than the strength determined at the age of 7 days.

III. Packages, Marking and Storage

Packages and Marking—8. The cement shall be delivered in suitable bags or barrels with the brand and name of the manufacturer plainly marked thereon, unless shipped in bulk. A bag shall contain 94 lbs. net. A barrel 376 lbs. net.

Storage—9. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight building which will protect the cement from dampness.

IV. Inspection

Inspection—10. Every facility shall be provided the purchaser for careful sampling and inspection at either the mill or at the site of the work, as may be specified by the purchaser. At least 10 days from the time of sampling shall be allowed for the completion of the 7-day test, and at least 31 days shall be allowed for the completion of the 28-day test. The cement shall be tested in accordance with the methods hereinafter prescribed. The 28-day test may be waived if ordered.

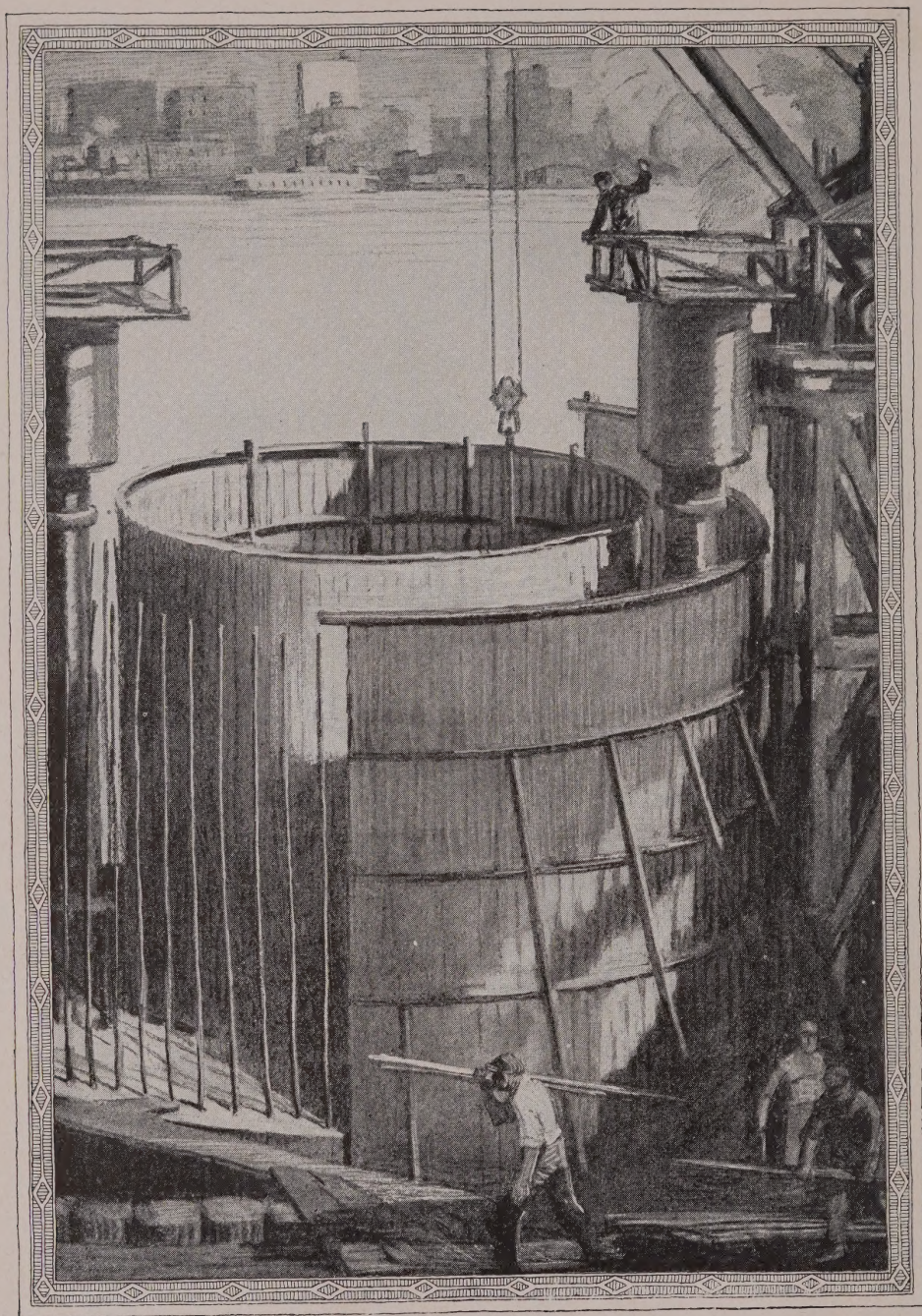
V. Rejection

Rejection—11. The cement may be rejected if it fails to meet any of the requirements of these specifications.

(a) Cement shall not be rejected on account of failure to meet the fineness requirement if upon retest after drying at 100° C. for one hour it meets this requirement.

(b) Cement failing to meet the test for soundness in steam may be accepted if it passes a retest using a new sample at any time within 28 days thereafter.

(c) Packages varying more than 5 per cent. from the specified weight may be rejected; and if the average weight of packages in any shipment, as shown by weighing 50 packages taken at random, is less than that specified, the entire shipment may be rejected.



East River Tunnel
(New York City)

BUILT to meet the transportation requirements of the metropolis for generations to come—this great tunnel connecting Manhattan with Brooklyn, stands high among the great engineering feats of the age. The illustration shows the construction of a massive concrete casting in connection with this undertaking. In this remarkable under-river work it was essential that the materials used be of the highest quality. ALPHA CEMENT met the rigid requirements of the engineers on whose shoulders rested the responsibility for the construction work.

ALPHA CEMENT — HOW TO USE IT

Cement Terms in Popular Language

Aggregates. The solid ingredients of concrete other than cement.

Batch. The amount of concrete mixed at one time.

Compression Stresses. Strains that act toward each other in the same plane, as in a wall or column under load.

Concrete. An artificial stone made from Portland Cement, sand and pebbles, broken stone, etc., with the addition of water and often reinforcing bars or wire.

Concrete Blocks. Building stones made from concrete, sand and usually stone of small sizes.

Density. The fewer the voids in concrete (air spaces between the particles) the denser (hence heavier) the mass.

Gauging. The mixing of a certain quantity of water with the concrete ingredients.

Granolithic. Troweled to a smooth surface.

Grouting. A mixture of cement and water thin enough to be poured.

Hardening. The stone-like firmness gradually assumed by concrete. This increases for years after it is placed.

Monolithic Concrete. Concrete set in one solid mass.

Mortar. A mixture of cement, sand and the necessary water.

Neat (Portland) Cement. Portland Cement mixed with just enough water to work it—no sand.

Proportioning. The determination of the proper quantities of cement and aggregates for a given quantity of concrete.

"Quaky Mixture." Concrete materials mixed to the consistency of jelly. Such a mixture will not require tamping.

"Quick Setting." Cement that be-

gins to set or harden before the usual time.

Reinforced Concrete. Concrete in which iron or steel shapes are imbedded.

"Setting." The loss of plasticity of a cement mixture. The beginning of this change is called the "Initial Set," the completion, the "Final Set."

"Slow Setting." Cement that permits ample time for mixing and placing before the final set.

Spading Forms. Thrusting a spade or other such blade down into freshly poured cement to eliminate voids and thus increase density.

Shearing Stresses. Strains that tend to cut a substance, like the action of scissors or the punching of a plate.

Tamping. Packing concrete down with a blunt-faced tool.

Tension Stresses. Strains that tend to pull a substance apart (as, for example, in stretching a rope).



Pouring a concrete pillar

"Could stand a nickel on edge"

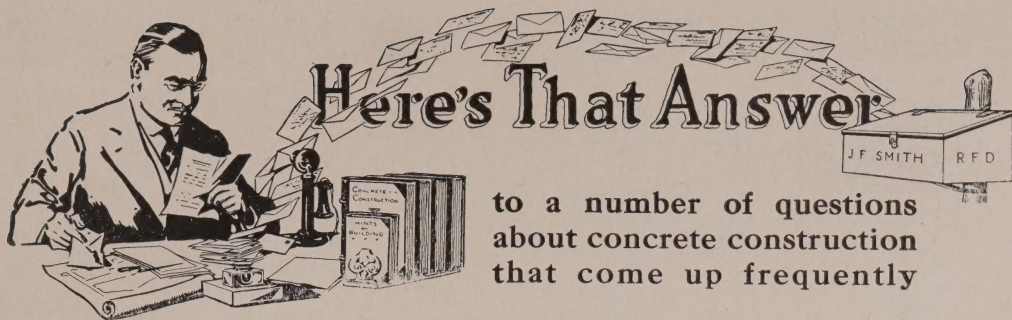
—Says the *Bush Terminal Company*
(New York)

"In one of our buildings two great paper machines turn out 100 tons of paper a day. While these machines were running at full speed, we demonstrated to a skeptic that the building was vibrationless by showing him that he could stand a nickel on edge anywhere."

In constructing the Bush Terminal Buildings, 415,000 barrels of ALPHA CEMENT were used, after meeting the most exacting tests.

The highest type of concrete construction is ensured in small buildings as well as large, by the use of
ALPHA CEMENT





to a number of questions about concrete construction that come up frequently

Where gravel must be hauled, and good sand is on the ground, does it not pay to use cement and sand exclusively? I must pay for all my hauling. How does a sand and cement mixture compare with a mixture of cement and graded gravel in strength?

It will require much more Portland Cement to make concrete of just sand and cement than it would if stone, sand and cement are used; and stone adds strength that sand cannot supply. Strictly speaking, the result is not concrete unless some material coarser than ordinary sand is used. Concrete, as the word is ordinarily understood, refers to some kind of coarse aggregate such as crushed stone, gravel, cinder, hard slag, etc., knit together by a mortar of sand and cement. The office of the sand and cement is to fill the voids in the coarser material and to knit the entire mass together in an everlasting bond. Cement is the most expensive material used in the making of concrete, and good sand, when the job is a large one, represents considerable money. Therefore, to eliminate the coarser material will not only mean weaker concrete but ordinarily will greatly increase the cost. Even if hauling expense has to be incurred, we recommend that this inquirer use a mixture of one part cement, three parts of coarse, clean sand, and five parts of clean gravel rather than to do his work with a mixture of one part cement to four of sand, which is as lean a mixture of sand and cement as would be advisable. Concrete that contains too much sand will "dust off" especially if considerable of the sand is fine. It is always desirable to have sand that has a good proportion of coarse grains.

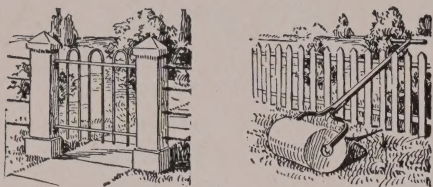
Sometime ago I put a concrete floor in my stable and it has turned out to be very satisfactory, with the exception that it is rather slippery. Can I do anything to correct this fault?

Your floor may have been smooth-troweled, which is not good practice for concrete surfaces that are to afford a safe footing for animals. Or possibly the grade from center to sides is too sharp. If the rise is not more than one inch in six feet, the following treatment is suggested:

Get a heavy steel hammer with a face similar to that of a shingle hatchet—that is, the face of the hammer should have the appearance of a series of pyramids, with the points approximately $\frac{1}{2}$ inch apart. Chip the surface of the concrete with this hammer. The floor will then likely be rough enough to obviate the danger of slipping and it will be unnecessary to add a top coating.

If your floor has a grade or rise of more than one inch in six feet and it is deemed necessary to regrade it, first roughen the surface as above indicated. Then give the floor a thorough sweeping or washing, so as to get off all the particles of chipped concrete. After this wash the floor with clear cement and water. While this is still damp, apply a 1:2 mixture, that is, 1 part of cement to 2 parts of good clean sand. This coat should be at least one inch thick in the thinnest place and the sides as much thicker as is necessary in order to bring the floor up to the required grade. While this coat is still soft, brush it with a coarse, stiff brush or broom so as to make a rough surface.

ALPHA CEMENT — HOW TO USE IT



How can concrete be made to knit together firmly when the work is done at different times?

It is always best to arrange to have the surface or finishing coat of concrete placed before the other concrete has fully set; then there will be no trouble about getting a good bond. However, when it is necessary that a facing or extra coat of concrete be added, after the completion of the other work, the surface on the old concrete should be thoroughly cleaned, using for this purpose a solution of one part muriatic acid to three or four of water. Let this wash stay on the surface until the concrete has been etched away enough to expose the rough aggregate. In this way, the new concrete will have something on which to get a grip. Before applying the fresh concrete, flush off the rough surface of the old concrete with clean water so as to remove the acid thoroughly and keep the surface thoroughly wet until the new concrete is applied. For such work, a mix of one part cement and two of sand will give the best results.

Often, when I am trying to get a nice, smooth wall, I find that pockets have been left in the concrete, and this makes the surface look unsightly when the forms are taken away. How can this be remedied?

The best way to remedy this fault is while the concrete is being placed. In the first place, the mixture should be mushy enough to pack down solidly and care should be taken to see that the larger stone used in the work is mixed well up with the smaller. But even when this is done, it is best at frequent stages of the work, to take a spade or other flat tool, and work this down between the fresh concrete and the outer form. This will shove the larger stone away from the

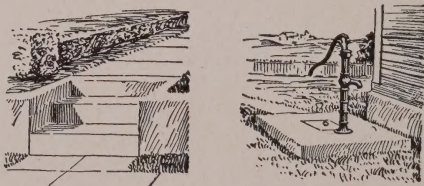
extreme edge and permit the fine material to work outward. It furthermore aids in making your concrete more dense, which is very important where the wall is expected to repel water.

What is the best way of preventing cracks in pavements and driveways?

Probably ninety per cent. of all cracks in pavements and driveways are caused by the action of frost. The remedy is a deep, well laid and well drained subbase composed of material such as cinders or ashes that will not expand in freezing.

Cracks come frequently from the neglect to provide for expansion and contraction. Concrete that is exposed to heat and cold is subject to a certain amount of contraction and expansion. The expansion joint should not be a mere ornamental line on the surface but should extend down through the slab. Some contractors provide for this by first laying only every other slab. When the first slabs are hard, the empty spaces are filled.

Fine or "hair" cracks are usually caused by too much fine sand or by excessive trowelling before the cement has taken its initial set; the trowelling brings the cement and fine material to the surface. Give the cement time for the initial set before beginning the final trowelling. Hair cracks do not extend deep and do not ruin the walk but mar its appearance.



A few months ago I put a concrete cellar wall in a house that I was building at that time. During the last week we have had some heavy rains and the water has leaked in. Is this the fault of the cement or poor mixing?

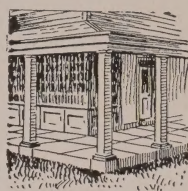
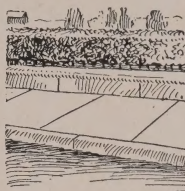
Your concrete was probably lacking in density.

ALPHA CEMENT — HOW TO USE IT

Numerous tests by various scientific bodies as well as by the Bureau of Standards of the U. S. Government have shown that the best way to secure a waterproof concrete is so to grade your aggregates as to secure the densest possible concrete. By this is meant, use stone and sand, the particles of which are varied in size so that the spaces between them when they are mixed together will be a minimum. A concrete made of aggregates graded in this way in which sufficient water is used to make a mushy mass and which, when placed in the forms, is well tamped and spaded, will generally be waterproof, that is, unless the wall is thin. By spading is meant shoving a thin, sharp-edged tool down between the concrete and the forms and also shoving it down into the center of the mass while it is being placed. This forces the larger stones back from the face of the concrete, and allows a mixture of rich grout to come to the exposed surface of the work, and releases bubbles of air in the center of the mass that would otherwise leave hollow spaces. Additional density can be secured by painting the surface of the concrete. (See page 30.)

It is very difficult, where a wall has already been built and found to be porous, to correct the trouble from the inside. It can be done by building an extra 4-inch wall with an open space of from 1 to 1½ inches between that and the old wall and providing a way for the water to flow out from this space into a drain; or by applying pitch and felt and an extra wall or layer of dense concrete, but by this method the floor must be a continuous, dense slab of concrete, otherwise the water will find its way under the floor and come up through that. Correction from the inside is troublesome and costly. It is better to get at the leak from the out-

side and by the application of tar and felt, a waterproofing compound or by a supplemental wall or mass of dense concrete on the outside, to keep the water away from the porous wall. As a matter of precaution, a drain should also be laid.



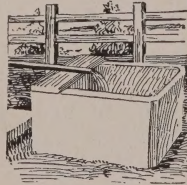
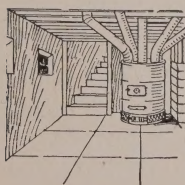
What is a simple rule for determining the amount of cement required by a certain proportion?

The following rule is one used by some contractors in getting a quick, general estimate of the cement required: Divide the total of the figures representing the proportions into 11 and use the result as the number of barrels of cement needed for a cubic yard of concrete. To illustrate: The proportions are 1:3:6; the total of 10 divided into 11 gives 1 1-10 as the number of barrels of cement required for each cubic yard of the volume to be filled. This rule gives approximately correct results.

During September, when we had some very cool nights, some concrete that I had in forms looked as if it were not going to set at all. I complained about the cement but let the forms stay and a week later the concrete was as hard as a rock. Can you explain this? I am sure the concrete did not freeze much, if any.

The following extract from the *Engineering News* answers this question well:

"The fact is that while most constructors realize that concrete will not set in freezing weather, many do not appreciate that from 45° F. down to freezing there is a definite slowing up of the setting, which is actually more dangerous than a complete failure to set. Anyone ought to be able to recognize a frozen concrete; it takes a much higher degree of skill to determine a working-strength set.



ALPHA CEMENT — HOW TO USE IT

“During the later fall, in most parts of this country, night temperatures will be hovering around freezing, although in the daytime artificial heating of the concrete will rarely be required. In consequence, much concrete from which normally the centers could be removed in two to three weeks, will be so retarded in set as to be dangerously near failure, unless supported for a week or two weeks beyond the standard period. If the discouraging records of all the autumns of the last ten years are not to be repeated, every man responsible for the laying of reinforced concrete will study his thermometer during October and November and be quick to protect his forms when the temperature gets into the forties.”

I intend to put a concrete floor in a small power house in which will be installed a gasoline engine that will be used for pumping, running cream separator, etc. How can I lay the floor so as to provide for bolting the engine down firmly?

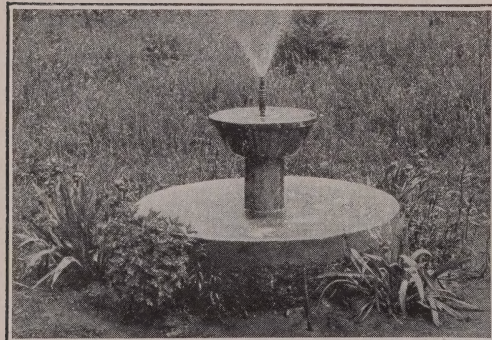
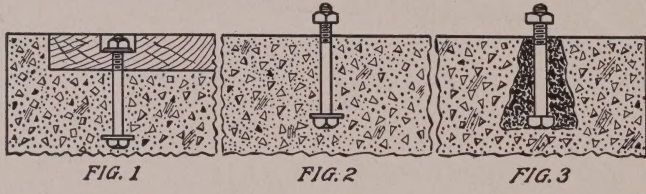
There are two ways of doing this:

one is to anchor pieces of hard wood, say 4 in. x 4 in. timber, in your concrete in the manner shown in Fig. 1, where the timber is set flush with the floor and is countersunk for a nut and washer.

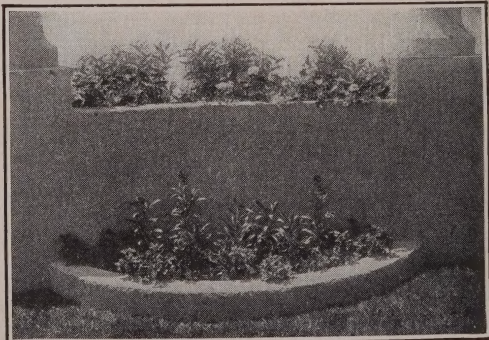
The other would be to set the anchor bolts in the concrete permanently (see Fig. 2). This can be done by making a wooden template of the base of the engine (a frame that will accurately locate all bolts and suspend them in position); place this template in the position

desired and fix the anchor bolts in the template at a proper distance above the floor.

If the concrete floor is already laid and you desire to anchor a gasoline engine to it, holes can be drilled in the concrete, as illustrated by Fig. 3, and anchor bolts securely fastened by lead, melted sulphur, or a rich cement grout. These holes can be drilled with an ordinary hand drill such as is used for drilling rock. Be sure the holes are drilled deep enough to give you a secure fastening for the engine, then place the bolts in the holes so that they extend at a proper distance above the floor, and pour lead, melted sulphur or rich grout around them.

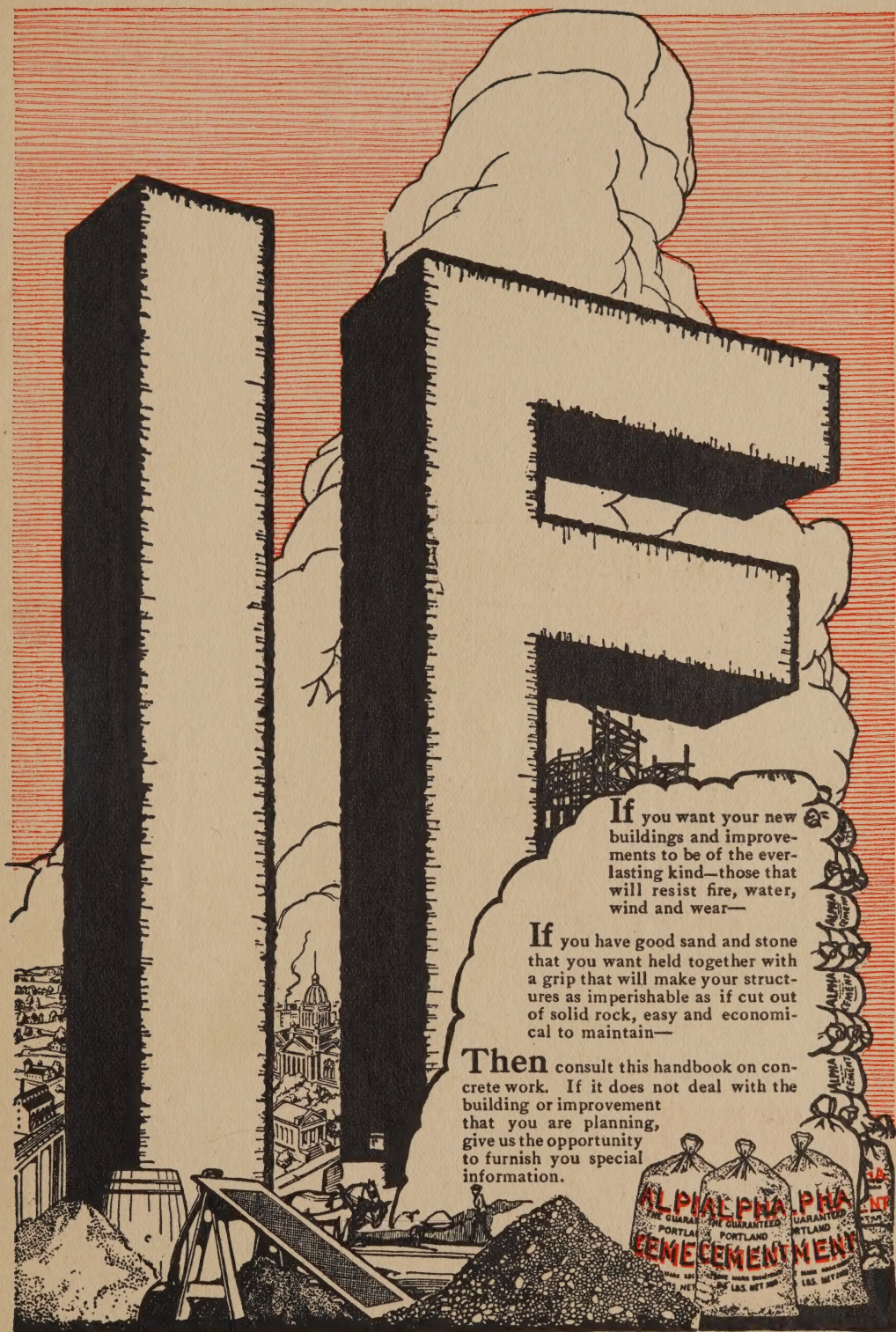


Concrete bird bath of simple construction



Use of concrete in making flower beds

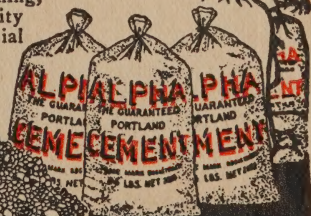
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